Teachers' and Students' Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment.

by

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DECLARATION

The work in this thesis was developed and conducted by the author between September 2012 and July 2016. I declare that, apart from work whose authors are explicitly acknowledged, this thesis and the materials contained in this thesis represent original work undertaken solely by the author. I confirm that this thesis has not been submitted for a degree at another university.

Papers in publication by the author

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ABBREVATIONS

ICT	Information and Communication Technology
DHI	Deafness and Hearing Impairment
SR	Speech Recognition
FM	Frequency Modulation
TSL	Turkish Sign Language
SL	Sign Language
OSL	Ottoman Sign Language
TDD	Telecommunication Devices for Deaf
MONE	Ministry of National Education
SEN	Special Education Needs
WHO	World Health Organisation
CAE	Computer Aided Education
AV	Audio Visual
BECTA	British Educational Communications and Technology Agency
SPSS	Statistical Package for the Social Sciences
WIE	Warwick Institute of Education

ABSTRACT

This doctoral research aimed to investigate the perspectives of teachers, principals and students on the nature and usefulness of ICT use in a Turkish special education school to support pedagogy and promote communication for students with hearing impairment. New ways of teaching and learning were assessed as a part of this study via creating an enhanced communication environment through a speech recognition program called "Dikte" which allowed participants to experience facilitated learning. Specifically, the beliefs on ICT use held by sixteen special education teachers, ten students with hearing impairment and three principals were examined.

A case study was employed as a methodological approach in this study. Questionnaires, interviews and observations were the methods for data collection on participants' views regarding ICT use and speech recognition (SR) program application. A case study approach was important in a sense that it allowed the researcher to deeply explore how ICT and SR were employed by engaging with students and teachers in their daily educational activities.

The findings suggested that ICT provide some advantages in supporting communication in class through access to better-developed hearing devices, social media tools and computer programmes. ICT/SR use had implications regarding pedagogical support including developing teaching and learning resources (e.g. classroom notes, audio-visual teaching, material in audio and text formats), shifting teacher to student-centred pedagogies and enhancing students' comprehension, motivation and social participation. The study also examined the factors that support or hinder ICT use in a special education school. Supporting factors were ICT knowledge of teachers and students (being digital natives), advanced ICT infrastructure that facilitated hearing features. Hindering factors were lack of school administration support, lack of support from the Ministry of National Education of Turkey, lack of in-service teacher training and knowledge of ICT use.

The study made a novel contribution to examining users' views about ICT as a tool for supporting teaching and learning in students with hearing impairment in Turkey, raising issues about the pedagogical and curricular implications for using ICT in special schools and the role of the state in supporting this.

CHAPTER 1. INTRODUCTION AND BACKGROUND TO THE STUDY

1.The Aims of the Study

The primary aim of this study was to examine how Information and Communication Technology (ICT) used in a special education school in Turkey for supporting pedagogy and promoting curricular and communicational access for students with hearing impairment. This study examined the perspectives of teachers, principals and students on the nature and usefulness of ICT with a particular emphasis on examining "Dikte", a Turkish speech recognition software program. New ways of teaching and learning were assessed as part of this study through creating an enhanced communication environment through a speech recognition program, which allowed participants to experience, facilitated learning.

A key objective was to obtain the views of teachers, principals, and students with DHI on the effectiveness of ICT in supporting students with DHI. Additional objectives included identifying facilitators and distractors of ICT use, strategies employed in implementing Dikte, curricular and pedagogical issues accompanying ICT, processes through which speech recognition (SR) programmes were employed in classrooms, and the systemic and organizational challenges associated with ICT use in a special education school.

1.2. Personal Interest in the Study

The impetus behind this study was to improve the learning opportunities for students with hearing impairments through technology. Technology offers unique opportunities to facilitate communication and social interaction for students with DHI through access to up-to-date educational materials, technological devices such as Frequency Modulation (FM) systems, cochlear implants, visual supplements (sign language interpreters), sound captioning tools (recorders and speech recognition software), and multimedia devices. These technological opportunities captured my interest as vital ways of minimising the physical, educational and social challenges faced by students with hearing impairments.

ICT have the potential to enhance access to learning and communication in society. My vision is to provide concrete solutions for applying ICT for the education of students with DHI, so their educational achievements can be supported and relevant challenges can be identified. By doing so, we can maximize the advantages of ICT to help students with DHI to have improved access to educational services, to participate increasingly in different aspects of public life, and to live independently. However, ICT cannot serve as a complete solution to all challenges experienced by students with hearing impairment. There are limitations to technology and we should have realistic expectations. The success of the implementation of ICT is determined through a dynamic human-technology interaction with the human factor playing a significant role, as such, it is important to support educators, policy makers, students, and parents to access the pedagogical, practical, social benefits of ICT. To date, there has been

little research evidence on the implementation of ICT, especially in students with DHI in Turkey. This is a fundamental gap in our knowledge and experience in this respect.

I believe this study can help to fill this gap by examining classroom communication between students and teachers as mediated by the SR software. Using a SR program for teaching and learning purposes may prove to be a major development in teaching and learning as it enables students with hearing impairment to access speech and engage with learning. The application of SR in Turkish special education schools for students with DHI is new and under researched with only a few studies available in the literature from countries other than Turkey. Therefore, the implications of this study are important for policy makers, school governance, educational entities, teachers and students and other key stakeholders. Findings of this study are expected to provide new teaching and learning advantages which could be applied in education.

1.3. The Setting and Background to the Study

The implications of integrating technology in educational practice have been discussed extensively among educators and policy makers over the last three decades (Eurydice, 2011; Lowther et al., 2008). A goal of implementing ICT solutions in education is to develop educational practices to prepare future citizens to meet the challenges of globalisation and a rapidly advancing technology (Papaioannou & Charalambous, 2011). Several research studies have examined the advantages of ICT in teaching and learning in terms of increasing student creativity, confidence, critical thinking and academic skills, as well as creating a positive learning environment where students are encouraged to pursue their interests, and interact with their families and teachers. (Williams, Jamali & Nicholas, 2006; Brodin, 2010; Petrie et al., 2014).

1.3.1. ICT and Educational Change

Educational systems in many countries have been influenced by the integration of ICT in teaching and learning (Ezziane, 2007). However, so far, the effectiveness of ICT in shaping teaching and learning is less clear. ICT should be carefully implemented, as a mere introduction of ICT in educational processes is insufficient. ICT implementation is likely to challenge the nature of teaching and the professional status of teachers, and helps to promote a student-centred education (Bingimlas, 2009). An UNESCO (2005) report investigating the impact of ICT concluded that current education systems, in general, designated the teachers using ICT as collaborators, guidance and resource persons, and facilitators of learning. Such innovative teaching techniques challenge the notion of teachers as the main source of received knowledge and assign the role of a collaborator, encouraging teachers to alter their traditional pedagogical beliefs, reduce workload by eliminating time- consuming traditional methods of paper and student-portfolio preparations, and adopt a student-centred approach to teaching (BECTA, 2004a; Balanskat, Blamire & Kefala, 2006).

There have been a number of ICT reforms supported by Turkish Ministry of National Education (MONE) in the last century; however, they were criticized by many local, national and international agencies (Unluer, 2011; Demiraslan & Usluel 2006; Özden, 2007). The key criticisms concluded that ICT reforms mainly focused on providing ICT infrastructure for schools rather than developing ICT pedagogy and the processes that underpin ICT mediated teaching and learning (Arkan & Gurleyen, 2015). According to the Global Information Technology Report 2015, the Turkish Government's level of success in the promotion of ICT in education is lower than that of European and other countries, with Turkey being ranked as the 68th country in the world. This raises important questions about the current capabilities of Turkish schools in making an effective use of ICT for educational change, since, for this to happen, Turkish schools largely depend on the support of Turkish MONE for ICT resources and directions for pedagogy. As studies on ICT in Turkish education have shown, there is a strong relationship between the quality of ICT resources that schools receive from the government (i.e., MONE) and the quality of education they offer (Kemaloglu & Kemaloglu, 2012; Eres, 2010).

1.3.2. Implementation of ICT in Education for Students with Special Needs

A significant contribution of ICT in the education of students with special education needs (SEN) is its capacity to reach individual students and meet their diverse needs (Anderson, 2010). ICT infrastructure creates a learning platform which aids curriculum planning, material design and delivery, development of better assessment tools in addition to fostering educational activities and collaborative learning among students with special needs (UNESCO, 2006). Murchland and Parkyn (2010) argued that ICT infrastructure support personalised access to curriculum and learning spaces and resources where students with SEN can create their own personal homepages, access study units and learning materials, and work collaboratively with their peers.

A study by Söderström (2014) showed that through ICT use students with SEN achieved well academically because learning was tailored to their needs. ICT provide new ways for presenting information to students with SEN. ICT tools include various computer software programmes which help students with SEN develop linguistic, spelling, writing and reading skills through access to creative learning environments such as educational games, and physical and mental exercises (Tautkeviciene & Bulotaite, 2009).

People with disabilities in Turkey experience limited physical access to educational resources (Uskun & Gundogar, 2010). Disabled people still continue to be the most isolated and neglected group of people by the education system (Eres, 2010). In fact, the Turkish financial budget for SEN support and services falls behind most other countries (WHO, 2015).

Even though Turkey has signed the UN Declaration of Human Rights on the educational rights of people with disabilities, the progress of educational change for people with SEN in Turkey has been slow (Uskun & Gundogar, 2010). Current attempts to use ICT in Turkish special education schools are

often neglected (Arkan & Gurleyen, 2015). Lack of SEN support stems from the lack of ICT resources, insufficient budget, poor staff training, urging role players (e.g., parents, policy makers, companies) to consider this if they truly would like to promote the education of students with SEN.

1.3.3. ICT for Students with Hearing Impairments

ICT are considered to be valuable technologies which provide, sustain and enrich the learning process by transferring knowledge, and decreasing the negative impact of existing disabilities for students with DHI (Wald, 2012; National Centre for Technology in Education [NCTE], 2008).

ICT for students with DHI are often grouped into three categories: (i) hearing technologies such as FM systems, hearing aids and cochlear implants, (ii) alerting devices such as visual or vibrating devices, (iii) ICT supporting enhanced communication such as telecommunication tools (captioned phone, cell phone/pager), closed captioning, voice to text/sign, real time captioning, electronic note taking and computer software programmes (Heckendorf, 2009).

ICT devices have created a plethora of new teaching and learning opportunities for a diverse group of learners. For example, speech recognition (SR) programmes provides new teaching and learning techniques and opportunities by synchronising captions, and generating transcripts of live and recorded speech (Bain et al., 2005; Wald, 2012). SR verbatim transcriptions help improve students' comprehension, particularly for those who struggle taking notes simultaneously with thinking and listening, as well as students who missed a lecture. The use of SR would be beneficial, for example, for students with physical health problems, mental issues, health issues such as impaired hearing or seeing (Wald, 2008). As highlighted in a research study "It's [using SR] like going back in time to the class and doing it all over again… and really listening and understanding the notes and everything… and learning all over again for the second time" (Leitch & MacMillan, 2003).

SR is likely to be helpful for students with hearing impairment, since it can synchronise speech with text, allowing students access text-based teaching and learning materials by replacing unnatural and unorganised speech with natural, recorded real speech (Wald, 2008; Zhili, Wanjie & Cheng, 2010; Shadiew, 2013). SR also provides visual materials along with audio, which means that students with hearing impairment may significantly benefit from the audio-visual information to comprehend speech (Baskent & Bazo, 2011). In parallel, Valkenier (2012) emphasises that understanding spoken language is not limited to processing auditory phenomenon but can be enhanced by visual information. There is an interaction between auditory and visual learning, known as the McGurk effect (McGurk & MacDonald, 1976), in that when auditory and visual information is presented simultaneously, it may create an altered enriched perception in the brain that is different from that created by auditory or visual stimuli alone (Valkenier, 2012).

Research studies have shown that it is crucial to use appropriately aligned audio-visual information for students with DHI who use hearing aids, since their auditory signals are damaged and being dependent on visual cues (Baskent & Bazo, 2011; Champoux et al., 2009). Similarly, Liu and Sato (2009) explained that people with hearing impairments mostly rely on visual cues in order to understand speech in daily life. Therefore, intermodal synchrony (lack of synchrony relating to more than one mode of transport) is important, as there are possible disadvantages of using hearing devices due to delays in the processing of signals and a potential asynchrony between audio and visual cues in telecommunication materials.

The sensitivity of audio-visual (AV) synchrony can be influenced by the degree of hearing impairment, with the impact being proportional to the degree of hearing loss (Baskent & Bazo, 2011). According to Auer and Bernstein (2007), people with moderate to severe levels of hearing impairment heavily rely on visual cues for effective communication; therefore, such persons may rely on the use of visuals and the integration ability of AV speech.

Widespread utilisation of visual cues by persons with DHI may lead to neurophysiological changes such as cortical reorganisation and improved perception of motion and peripheral stimuli in the brain (Mitchell & Maslin, 2007). Strelnikov et al. (2009) suggested that students with cochlear implants also rely on visual cues for deciphering spoken language, since cochlear implants cannot always accurately transfer sounds and may sometimes distort some sounds. Therefore, a multisensory integration of AV elements is crucial for the development of the communication skills of students with DHI.

Many studies in the last decade have highlighted the inadequate adoption of ICT in Turkish special education schools for students with DHI (Trucano, 2013; Wastiau, Blamire, Kearney, Gaer & Monseur, 2013; Sari, 2013; Kemaloglu & Kemaloglu, 2012). Most schools are traditionally oriented with a hierarchical structure and a prominent teacher-centred approach to learning, and often lack the necessary facilities for accommodating the specific needs of students with DHI (Usun, 2009). A reformation of existing hierarchical structures for meeting the specific needs of students with DHI in Turkish special education schools is an arduous process (Cavkaytar, 2006; Tufan, 2007; Gokmen, 2007; Kemaloglu & Kemaloglu, 2012). Rather, these schools expect students and their families to adapt to the existing structures of the school. Indeed, Girgin (2012) argued that traditional schools for students with DHI tend to resist change, making it difficult to employ ICT and approach the students as active learners.

1.4. Research Questions

Research question(s) aid the researcher to identify the main purpose of the research and determine the relevant directions for the research project. Hammond and Wellington (2013, pg. 127) argued that "the research question or questions provide the starting point for considering the research methodology". In light of this definition, the research questions were:

1) What are the views of special education teachers', principals and students on the usefulness and effectiveness of ICT, Dikte in particular?
2) What are the implications of using ICT for pedagogy, curriculum, teacher training, teaching and learning in pupils with hearing impairment?
3) What are the facilitative and hindering factors in integrating ICT in teaching pupils with hearing impairment?

1.5.Structure of the thesis

The thesis is structured in six chapters including the introduction. The Introduction provides the background and aims of this thesis. Chapter two presents a critical review of theoretical and analytical concepts of ICT use in general and in special education schools and also identifies the gaps in the literature. Areas covered include ICT in education, ICT as a pedagogical tool, implementation of ICT and resulting educational achievement, implementation of ICT in the education of students with SEN and DHI, facilitators and distractors of ICT, utilisation of ICT by special education teachers, perceptions of ICT, the use of SR program and relevant outcomes in education. Chapter three is the methodology, which focuses on the research design, data collection and analysis along with a discussion on validity, reliability and ethical issues. Chapter four presents the results with a detailed analysis of the data. Discussion is chapter five where the findings of this study are compared and contrasted with the literature and conclusions are drawn. Chapter six is presents the overall conclusion including final remarks, the theoretical and practical implications and significance of this study, strengths and limitations, and recommendations for future studies.

1.6.6. Dissemination of Results

The study findings will be disseminated through peer reviewed publication and presentation at relevant conferences.

1.7. Turkish Speech Recognition Software "Dikte"

Dikte is a real-time speech-to-text transcription software program, which allows a computer to identify and understand spoken words, and translate sound input (oral delivery) into texts format. Dikte involves a teacher speaking into a microphone. The speech is recognised and shown synchronously in the form of text, and at the same time the speech is recorded in sound format (see figure F. pg. 96).

Dikte can be controlled in two ways. It first offers dictation/editing through the use of voice commands, including 'select', 'delete', 'capitalise', 'put comma', 'put dot', 'put parenthesis around' etc. A second way of controlling Dikte is with a computer keyboard, which is used to change words which are not recognised properly or recognised incorrectly, as well as to edit texts, insert links, pictures, graphics etc. into the texts. Furthermore, the keyboard helps to start or stop Dikte, and to enable the cursor to move and write in different word documents. The first method that of dictation by punctuation is the

most used strategy in Dikte. This has a crucial importance in providing intended meaning to the language, because, use of the wrong punctuation mark can convey a completely different meaning or convert the sentence to complete nonsense. This feature of Dikte can promote pedagogical benefits where the reading and comprehension skills of students could be enhanced, depending on the fact that reading an unbroken stream of texts without proper punctuation makes it difficult to comprehend writings. Because writing with punctuation gives meaning to written words similar to pauses and changes in tones of the voice during speaking, it leads increased comprehension both at the word and the sentence level. For instance, the use of commas, as well as other punctuation marks, can completely change the meaning of the sentence, as the example shows "kill him, not let him free "and" kill him not, let him free".

Dikte has a speech recognition engine which takes an audio stream as input and turns it into a text transcription, and records it in a file which can be printed as a note. This functional feature of Dikte enables users to print lectures or any other forms of verbal-oral teachings in text format. Notes covering oral teachings may play a significant pedagogical role for students in general and especially for students with DHI. First, providing classroom notes supports comprehension skills, since enabling the students to receive all the covered subjects in hand and being able to study them. By doing so, any information missed, misunderstood or partly understood could be compensated for. Also, in Dikte, printed notes enable students to locate some of the words that they do not understand in aural form but could better understand in written form. This is especially applicable to those with DHI, who may not easily comprehend learning subjects in aural forms, but rather prefer written formats. Since the problems these students experience in accessing and understanding auditory inputs, possible information missing from oral teachings is not unusual or commonly experienced. In addition, for those who use sign language to communicate, missing information is possible where not all words, prefixes, suffixes or other language components can be signed, which inevitably decreases the quality of information transfer through sign language. In this sense, classroom notes in written format become more important. For these reasons, notes taken by Dikte may have significant pedagogical importance in enhancing the comprehension skills of students with DHI.

Another functionality of Dikte is that of editing transcribed notes. Editing features include correcting mistranscribed words, highlighting, inserting texts, changing text characters, underlying, colouring, synchronising links into text and modifying texts depending on the purpose of their use. This can be used for different pedagogical purposes: for instance in order to increase comprehension, words, sentences, paragraphs can be highlighted, modified by adding links to webpages, videos and other sources of information. Depending on the fact that students with DHI are mostly visual learners, teachers can insert additional visual information such as symbols, indicators, sign language pictures or videos by synchronising into text and use different colours which can support the students' comprehension skills.

In terms of the Dikte sound recording feature, users' speech is recorded simultaneously during Dikte's operation. Later, this sound recording can be listened to again through a special feature, where Dikte shows which words are being listened in yellow colour to enable listeners to track speech and transcript (see figure H). Hence, students are able to listen to the records that provide pedagogical opportunities of developing listening skills, comprehension skills and being familiar with the individual accents of the teachers'. The fact that hearing skills of students with DHI are deprived, they need to exercise listening more than typical hearing people, especially their teachers' voices since they are one of the main information source for their learning. Therefore, Dikte sound recordings helps the students in being more familiar with individual accents of their teachers, common words or expressions that they use in speaking, academic words that are specific to subjects and daily conversations. Also, having sound recordings enables students to work individually outside of classroom environment, which could be noisy or disturbed in terms of listening/sound acquisition quality.

Dikte transcribes oral delivery into text to various degrees of accuracy. Accuracy depends on several factors, including the speaker's pronunciation ability and Dikte's dictionary, which sometimes experiences difficulty in transcribing specific terminologies (for further information, see pg. 46). It is important to highlight that the errors made by Dikte may be different from keyboard typing errors. In typing, users can be quite certain of the results of pressing keys on a keyboard; however, in Dikte/SR use, the errors are generated by a mismatch of the system between input and output. Therefore, mistranscribed words may involve the whole word or a small part of the words. Special attention should be given to the pedagogical impact of Dikte on students' reading skills in this respect. Because transcribing errors occur during Dikte use while students simultaneously read them from the screen, this might negatively affect their reading fluency and comprehension skills.

In order to improve Dikte's transcribing accuracy, there is a special Dikte module called "speech training". Users record their voices (in individually created user profiles) by pronouncing a few hundred words most commonly used in Turkish and also specific subject related words (physics, chemistry, mathematic etc.) that teachers use in teachings (see figure I). When users speak these words during Dikte operation, the system recognises individual language accents, pronunciation differences and characteristic voice features. Therefore, the more Dikte is used and the more it records the users' voices, the better it will transcribe speech.

Another functional feature of Dikte is to create individual teacher files to store materials in an orderly fashion. So that, tracking, sorting, accessing and storing Dikte text and sound files can be more easily based on the teaching subjects and individual teacher/user profiles.

Dikte is the most developed speech recognition software program, being specifically designed for the Turkish language by Intel with a very large vocabulary database. However, it still has a limited vocabulary bank, and the speech may only be identified if it is spoken clearly. Also, the processing speed

of the computers where Dikte is installed and used is critical, because it affects how fast the computer can search the RAM for word matches. In this way, faster processors and more RAM capabilities increase the Dikte's operation features. A detailed description of the features of Dikte may be found at www.dikte.com.tr . (For further information about SR, see pg. 54).

This study is important as it can help shed light on ways of using ICT in special education schools for students with DHI. Many studies have investigated the theoretical underpinnings of ICT in special education schools; however, studies examining practical ICT interventions in real classroom environment are somewhat limited in the literature. Therefore, this study is important for providing real-life experience of ICT utilisation in a population of people who are underrepresented in research studies. In the Turkish context, there is scarcity of research on the practical aspects of ICT use in class to support the teaching of students with DHI. Therefore, a fundamental research gap exists in this area. This study aims to fill this gap by offering insights on how Dikte, a speech recognition programme, can be used to support teachers and students, and offer advice on the structures that facilitate or hinder ICT use.

CHAPTER TWO: LITERATURE REVIEW

Introduction

This chapter examines literature review on ICT and SR use in special education schools for students with SEN and DHI. It begins with a review of theoretical perspectives on disability in terms of the nature and meaning of disability and the solutions offered to support individuals with disabilities. This is followed by a review of literature on ICT accessibility and implementation for people with SEN and DHI worldwide and in Turkey in particular.

Also, progress of education systems impacted by ICT application was reviewed including socio-cognitive outcomes of ICT, effects of ICT in developing social participation and motivation, and ICT support in academic skills such as reading, writing, comprehension, listening, speaking and vocabulary learning in students with disabilities. Further, a review of literature on facilitative and hindering factors about ICT in education was offered. A wide range of studies showed that while there was limited discussion on facilitative factors, hindering factors were reported extensively. Also, the literature about curriculum issues including standardised or individualised curriculum in special education context was reviewed.

Finally, Speech Recognition (SR) technology was reviewed. The review begins with general functions of SR and its application in education. It is followed by studies on how SR has been applied in special education contexts, including SR use for students with DHI in terms of supporting developments in audio-visual transfer of knowledge, note-taking, material producing in audio (sound recordings) and visual (text transcripts of speech) formats. This chapter ends with a discussion about SR usage considerations including the accuracy of transcribing speech into text and the effectiveness of notes taken by SR.

Theoretical Perspectives on Disability

The nature and challenges of disability and our approach to it differ in each society, which is likely to create different perspectives, practices, administrations and public investment. Hence, there have been many documented perspectives and approaches reflecting cultural points of reference regarding disability. One of them defines disability as the biological defects of individuals who are mostly dependent on the support and care from others (Rioux & Valentine, 2006). According to this approach, the mobility of people with disabilities can be bounded on account of the reality of being dependant on others' availabilities such as knowledge, resources, attitudes etc. Another perspective approaches disabilities as "normal variations of the human body" and describes it as follows: "it is not an aberration. It's a reality, not an anomaly or abnormality" (Potok, 2012, pg. 11). This approach has been supported by those who acknowledge disability as something that could happen during the lifetime of any human

being. Supporters of this perspective especially welcome disability as normal, and support the designing and employing of adjustments to meet and accommodate the needs of the people with disabilities in society as far as possible (Iverson & Stahl, 2003). Universal adjustments, commonly called Universal Design, have been long discussed by governments and supporters of the rights of people with disabilities worldwide. Universal design in general concerns the full range of human diversity, not just people with disabilities, including physical adjustments, cognitive skills and the bodily differences in people. There is a wide range of possible adjustments that can be applied in universal design such as in architecture, urban planning, private residences, transportations and the digital and technological world, including computers, internet, educational materials, software and many of other areas. Common examples of physical adjustments include curb cuts in pavements, automatically opening doors and door handles, visual alerting, sound alerting and signals such as in elevator or crosswalks, separate spaces for wheelchairs and guide dogs in buses, appropriately designed lifts and ramps in airports and public buildings, and many other adjustments. Universal design applies to all people by recognizing the full range of human diversity, and there might be times in which any person may use these designed facilities because of temporary or permanent illness, injury or old age.

The Biomedical Model

The biomedical model of disability has been discussed in study of MacPherson, Pothiers and Devlin (2006) which stated that this model accepts the limitations and impairments of the human body and related treatments for the purpose of providing medical opportunities for transforming or curing disability. This approach has been supported in popular culture, where individuals with disabilities are considered to be biomedically different, and so called "defective" or "afflicted" in relation to "normal" people (Bohman, 2012, pg. 33). The doctrine of this approach supports mainly medical contexts, to ensure that people with disabilities receive all the available treatments to be able to live in comfortable conditions. The criticism raised against this model is that the lack of cure for disabilities that people experience poses significant limitations. Since today's biomedical treatments cannot address all the health- related problems of the people with disabilities, their current suffering might continue, which eventually restricts this model's effectiveness to adequately address people with disabilities (Macoherson, Pothiers & Devlin, 2006).

The Social Model

The core of this model is the idea that society itself creates and has to deal with the disabling conditions where individuals with disabilities experience social injustice or discrimination, known as "ableism" (Morgolis, 2001). The term "ableism" refers to the discrimination of society against individuals with disabilities mostly in favour of typically developed people, considering them as bodily or mentally different, strange or even going beyond politeness by referring to them as "inferior" (Morgolis, 2001, pg. 14).

The social model encourages society to rethink and redesign the physical and virtual environment to tackle the disabling conditions that create barriers for people with disabilities to fully participate in society. These conditions vary regarding the characteristics of the disability and the social environment. For instance, the absence of accessibility to public buildings causes physically disabling conditions for a wide range of people such as people with inability to walk who need wheelchair accessibility, and for individuals with deafness or hearing impairments who need sound and visual alerts. In terms of virtual environments, technology and any techno-related materials should be designed to focus on accessibility in a wider context to allow people with disabilities to use technology in their lives. For instance, captioned and subtitled TV programmes, educational videos, news, sign language converting materials, and so many other features of what technology can offer today benefit people with DHI in various ways.

Hughes (2010) stated that technological and medical assistance may prevent discrimination against people with disabilities, such as discovering some of the disabling issues before and after birth, so as to be able to deal with them more successfully to ensure children do not suffer unnecessarily. To illustrate this, opponents of cochlear implant from the deaf culture tend to consider medical devices as "an affront to deaf culture and their loyalty to sign language" (Bohman, 2012, pg. 36).

The gap between the biomedical model and the social model may be closed to a significant degree by unifying both their strengths in another model, referred to as the Capability Model.

The Capability Model

Sen is one of the most influential supporters of this model in his studies in 1979, 1988, 1992, 1995. The main standpoint of this model is based on establishing an environment where people with disabilities can take advantage of the strengths, social transformations and biological enhancements. As such, it offers a unified approach to both models by taking into account their strengths, and combines them to create a large spectrum of opportunities from which individuals with disabilities may benefit. The main points covered in this model include developing social welfare and freedom for people with disabilities, promote justice, support their human rights, and ultimately taking an interdisciplinary approach to unifying political and social philosophies, questioning economical conditions such as the level of poverty and inequality of economic power distribution, and improving the social relationships within societies (Bohman, 2012).

Sen argued that societies need to support consistent freedom, in the form of healthy life, education, enhanced social relationships, opportunities to take part in politics and decision making and improved economic welfare (Sen, 2002). This model values the choices of people with disabilities to decide whether to accept, choose, or deny available freedoms in their lives since freedom means having a total control over their choices. Based on this idea, this model appreciates any freedom whether acquired through social channels or medical treatments.

ICT Accessibility for People with Special Education Needs

The twentieth century, with its technological developments, has provided various effective high-tech technologies and assistive devices, especially for those with disabilities. Technologies that do not require another person to assist and can be used by individuals with disability "[have] never been more realistic and achievable" throughout the history than today (Bohman, 2012, pg. 18). The possibilities of today's technologies have certainly broadened the understanding of human and technology interaction, especially for people with disabilities.

A large array of assistive technologies has helped individuals to experience the world independently in ways that they could not experience it before. Some of the numerous technologies include computerized speech synthesizers to utilize communication for people with speech disorder or inability to talk, screen readers and other text-to-speech software for people with visual impairments, motorized wheelchairs which allow people with physical impairments to be integrated into normal social life without the need for being carried or pushed, speech-to-text software for those with deafness or hearing impairments etc.

According to May and Zhu (2009) the ICT accessibility needs of people with disabilities regarding technology and web sites has not been fulfilled, and debates have been taken place since the late 1990s amongst disabled people and government entities (Milley, 2010), educational institutions (Kane, Shulman, Shockley & Ladner, 2007) and private sector web sites (Kreps, 2008; Lopes, Gomes & Carrico, 2010). Because of the impact of long lasting law suits and complaints in regards to creating accessible ICT for people with disabilities, there have been many regulations and guidelines generated by government entities such as the World Wide Web Consortium (W3C). This has provided guidelines and recommendations regarding how to create ICT accessibility in technologies and web sites to meet the needs of people with disabilities, first published in 1999 and updated annually. Abraham (2009) stated that ignorance and intentional practices to decrease spending on ICT accessibility for people with disabilities is a crucial matter for technology and web developers. One of the barriers found in Abraham's study was finance. He examined the time period between 2000 and 2006 in terms of meeting the technological demands of people with disabilities and concluded that technology professionals have been slow with designing assistive technology accordingly, because they consider this market as less profitable. However, mostly after 2007, the author claimed increasing awareness of ICT accessibility and technology productions among technology professionals, and people in general, as a result of sanctions and enforcements, and also among people with disabilities' based on their demands and protests, human rights organizations efforts, support from the society in general, and the promise of technology itself. It is worth emphasizing that today's fast-paced developments of technology encourage professionals to generate technologies in digital formats (Abraham, 2009). Moreover, a growing professionalism in business, education, and health have supported a rapidly increasing environment for competition among

companies and government entities in various sectors, such as health, military, education and individuals. Hence, once mostly neglected group of people has become a beneficiary of these developments, in which ICT accessibility has increased and ignorance and exclusion of people with disabilities have begun to diminish in society (Krazit, 2009).

Fast growing technology transforms ICT materials into digital formats and the prevalence of ICT has never been more obvious throughout human history (Newell, 2011). A considerably larger number of people communicate through computers, phones and the Internet, which became a common way of interacting with others and achieving information. As such, today's digital world inevitably encourages everybody –especially in developed and wealthy countries- to be knowledgeable and productive citizens regarding technological developments, for the purpose of enhancing information transfer, decreasing time and money spent on communication and generating new tools for various purposes (Mattern & Floerkemeier, 2010). Disabled people are unavoidably in need of accessible ICT tools to be able to obtain information easily and develop appropriate communication channels with other people worldwide. Accessibility to ICT allows and encourages these people to feel integrated in the society and eventually in a world where people with diverse abilities interact and communicate with each other. Another contribution of ICT would be in overcoming social discrimination of people with disabilities. This is certainly a long term effect of ICT, but essentially it has the potential for social transformation where ICT accessibility changes attitudes against disability and help people to adjust to this new transformation, in which society is responsive to the needs of people with disabilities (Bohman, 2012).

Digital ICT allow people with disabilities to interact with the world, especially when appropriate software and hardware materials are provided in alignment with these individuals' specific needs (Samant, 2013). For instance, people with blindness can be provided with text-to-speech and text-to-Braille ICT tools for the purposes of translating any written text materials into sounds or Braille documents. Moreover, audio descriptions of videos or visual materials provide diverse advantages for obtaining information in effective ways. A similar means of conveying information could be for people with dyslexia.

In the past, non-digital technologies have played a crucial role in the transmission of information for people with disabilities mainly through direct interaction such as speech, conversations, and lectures and through analogue technologies, including TV, radio, text, telephone, telegraphy and other written document versions (Vanderheiden & Treviranus, 2011). According to Bohman (2012), people with disabilities have taken advantage of these devices for communication and obtaining information. However, the accessibility and adaptations of these devices have been limited to some degree, for a number of reasons: inaccessibility and unavailability of TV sounds, radio broadcasts, telephone conversations, videos, news and many others. The analogue ICT devices available for students with DHI included printed transcripts of the contexts of TV programmes, radio broadcasts, news etc. Also, a

telecommunication device called text-to-voice relay service, which translates written text into voice through an intermediary person, has been used to enable people with hearing-impaired to communicate with each other and with typically hearing people. Another communication access is based on text messaging over the phone between individuals with DHI. This has long been used in the deaf community as a primary method of communication (its use still continues, with more advanced smart phones allowing visual live communication and video chat via sign language).

Analogue ICT technologies for people with DHI have demonstrated a lack of flexibility and convenience due to the unavailability of transcripts for TV and radio programmes those have to be provided before or after these programmes. Hence, individuals with DHI depend to a large extent on the service of professional transcriptionists, which implies time and budget arrangements. When we also consider the number of individuals with DHI who are willing to obtain these services and the available professional transcriptionists, lack of services is not difficult to predict. When it comes to using the telecommunication device for deaf (TDD) service, these are not easily transportable devices, and require a stationary phone line. People with DHI who use TDD have to be at home or in other locations with TDD, which limits the movement of these individuals within their communities. Moreover, where there is no TDD, making a phone call from such places as schools, hospitals, hotels, shopping centres, houses of friends or relatives or any other public locations would most likely be unfeasible (Bohman, 2012).

The above-mentioned issues and the inconvenience of analogue ICT can be managed to an extent through a proper usage of ICT for the purposes of improving the communication features and opportunities of people with DHI. It is crucial that today's ICT developers should first examine the needs of these people and produce ICT devices and content appropriately aligned to accessibility in practice (Samant, 2013).

A brief history of ICT Implementation in Turkish Schools

ICT use in Turkish education policy began in 1984 with the introduction and integration of computers into Turkish schools. Since 1984, the Turkish Ministry of National Education (MONE) has been supporting ICT usage by financially investing to resources, implementing new up-to-date technologies and conducting a variety of projects and studies to address the educational needs of teachers, students, administrations, families and other components who are involved in teaching and learning processes (Orhun, 2010). To address ICT development, one of the first initiations was that of the Computer-Aided Education (CAE) Project, which has been actively implemented by the MONE since 1984. The main purpose of this was to spread computer literacy among teachers and students by introducing basic programming to begin building improved learning environments and to seek the first outcomes of computer usage in Turkish schools. However, the CAE project has been actively put into practice in 1990 as part of the World Bank National Education Development Project, because of obstacles such as lack of available software and shortage of trained teachers and trainers. Regarding the

main goals of this project, MONE trained 5000 teachers in 396 secondary schools around the country, and provided 6000 computers, along with courseware related to 140 teaching and learning subjects (Orhun, 2010).

MONE has financed a large number of projects to spread ICT usage for educational purposes all around the country. Some of the main examples of these projects are "Catching the Epoch 2000" , "Project for Globalization in Education 2000', 'Basic Education Project, Phase-I" , the E-Government" project , the "Improvement Project of National Education" and the "MONE Internet Access Project" (MONE, 2007). By implementing these projects until 2007, 2837 technology classrooms with computers and other technological tools were built in 2451 schools. Also, 2837 server computers, 42205 computers for students, 2460 computers for teachers, 2370 for administrators were provided by the MONE. Additionally, more than 10000 schools and 300000 computers were provided with Internet connections until 2007 (Cavas et al., 2009, pg. 2).

MONE introduced a new ICT/e-learning project in 2010, and this has been the last ICT project by MONE to date. The project is called "Movement of Enhancing Opportunities and Improving Technology" (known as FATIH project in Turkish). This project aimed to create "smart classes" in all elementary and secondary schools in Turkey by providing laptops, smart boards, digital projectors, multi-purpose copier machines, digital e-learning materials including e-books (Uluyol, 2013). The project targeted 40000 schools, around 570000 classrooms and 600000 teachers across Turkey. A distance education platform is a part of this project, which provides e-book and e-school features. E-book contains the electronic copies of all books and supplementary materials in digital format. E-school works to create a school management system where all students' educational records are available online. The most interesting part of this project has been to provide tablet computers for 2.5 million students in Turkey, aiming to complete this process by 2013; however, the project was extended until 2016. The main purpose was to load teaching subjects in digital format into these tablets and track students' educational outcomes, within this new e-learning environment. The planned time to complete this project was 3 years, and cost nearly 3 billion Turkish Lira (around 1 billion GBP or 1.8 billion US$ in 2010). However, the lifetime of this project has been extended until 2016 in order to fulfil the planned activities.

Education and ICT Application

Smith (2011) suggested that the educational uses of ICT have considerable potential to empower new forms of teaching, which can break the traditional hierarchies of educational systems. For instance, teachers' roles have dramatically changed from teacher-centered instruction to student-centered learning. In the traditional model, teachers were mostly considered to as recall facts, to being the expert or the most knowledgeable person in his or her field, to be the only authority of teaching in classrooms

(decision-making authority), to give lessons largely based on verbal transfer of information, and to be the evaluators of knowledge etc. (Starkey, 2010; Archambault & Barnett, 2010). A large volume of literature suggests that in ICT integrated education models, teachers' roles change to become facilitators of learning and collaborative inquiry with technology, and developers of educative materials based on ICT to sustain pedagogical interventions. Law et al. (2011) pointed out that teachers facilitate learning by creating and customising multimedia teaching materials with ICT, including basic and complex educational software. Their main role is not to make decisions, but rather to encourage reflection and an exploration of learning activities, experiences and tasks in the education process. Facilitating learning also occurs in many other formats by using ICT, including the employment of videos, films, animations, cartoons and simulations. Zhang, Hong, Scardamalia, Teo and Morley (2011) suggested that teachers could build a new understanding of studying subjects by applying these ICT.

Teachers' traditional roles have also changed in terms of guiding collaborative inquiries with ICT. It is obvious that teachers play a guidance role in the traditional model; however, ICT enabled them to bring people/students together (individually and in groups) in collaborative learning activities and decrease students' dependency on teachers in this respect (Tondeur, Keer, Braak & Valcke, 2008). In collaborative learning, ICT provide several opportunities, including teleconferencing and video conferencing, emails, interactive whiteboards, social media tools, educational software in reading, writing, listening, speaking developments, and so on. These ICT in teaching becomes main source of learning rather than teachers (Ulmane & Ozolina, 2011). However, as Niess (2013) suggests, teachers can still maintain control over ICT under these circumstances. For instance, they outline educational achievements, evaluate implementation processes and track students' academic developments.

In terms of developing or modifying the pedagogical perspectives of teachers, various studies have pointed to the importance of how ICT are incorporated into pedagogy. Watson (2001) suggested that a range of personal theories of teachers might be aligned with technology. For instance, teachers are beginning to understand the teaching and learning potential of a new technology and are seeking ways of implementing these in the classrooms. Mishra and Koehler (2006) have indicated that through the application of ICT, teachers are able to develop new ways of representing subjects in more accessible and comprehensible formats, engage in purposeful interaction and enhance the efficiency of knowledge transfer as a part of pedagogy. For instance, the use of multimedia simulations, smart boards, web-based hypertexts, animations and educative videos may likely to provide new ways for teachers to adopt the necessary pedagogical understanding. Law et al. (2011) explained how ICT enable teachers to modify their pedagogical knowledge, and concluded that teachers could design new teaching materials and learning activities with ICT, and therefore would need to learn new information and adopt it into their pre-existing pedagogies. Similarly, they may assess students' knowledge and monitor their learning progresses with ICT, rather than largely depending on the traditional paper-based formats of assessment.

New assessment systems may generate new forms of evaluating success criteria. Hence, teachers may need to learn how to interpret the assessment results provided by ICT and their new pedagogical meanings (Lim & Chai, 2008).

Student-Centred Learning

Today's education has been reported to be moving through student-centred learning even though the progress is slow, and the belief that students are considered to be passive recipients of information has been changing (Richardson, 2008). ICT usage to improve the educational achievements of students marks a shift from traditional teacher-centred learning to student-centred learning, which is described by Means and Olson (1997) as "using technology to promote student learning through collaborative involvement in authentic, challenging, multidisciplinary tasks by providing realistic complex environments for student inquiry, furnishing information and tools to support investigation, and linking classrooms for joint investigation" (Means & Olson, 1997, pg. 9). Literature studies suggest that ICT are helpful in shifting students' types of knowledge from a mere reproduction of data and acquisition of basic skills to constructing mental representation of meanings (McAlister, Dunn & Quinn, 2005), obtaining information cooperatively by interacting with experts, peers, extracurricular materials, and technological resources and by critically analysing facts about related subjects to their learning. This means that they can be active learners, and engage in different tasks by using new strategies to transform knowledge dynamically (Andrews et al., 2007).

The Role of ICT in the Inclusion of Students with DHI

Inclusion of students with DHI in mainstream has been a topic of debate over the last decades among educators, parents and education authorities (Norwich, 2008; Fortes & Pimentel, 2010). There has been positive evidence for mainstreaming, while opposing studies indicate negative evidence and perspectives (Starcic, 2010; Kolenc & Lebaric, 2007; Kavkler, 2007). In this regard, Norwich (2008) described this process as a dilemma. For instance, Kavkler (2007) supports inclusion by claiming that "inclusive education constitutes the inalienable right of children with special needs to appropriate and effective education in mainstream schools" (Kavkler, 2007, pg. 77). Similarly, Opara (2007) suggests that students with SEN and DHI in the mainstream are likely to experience mutual acceptance and respect. However, evidence is inconclusive, because several studies have reported that mainstreaming has negative affects on students with DHI. For instance, Komesaroff (2005) has argued that mainstreaming students with DHI could deprive them of receiving quality education, even though interpreters or a resource room may be provided. This is because in mainstream classrooms, the general needs of hearing students tend to be prioritized, and as a result limited adaptations for students with DHI take place, which eventually constrains the implementation of ICT (speech recognition programmes, text-to-speech software, sign language converted videos, subtitles for movies and videos etc.) The author further

explained that teaching styles and classroom management strategies of instructors in mainstream schools are aligned with hearing students' needs, posing an impracticable model for students with DHI. He therefore supports the view of creating bilingual schools where instructors with specific training in educating individuals with DHI should serve at all levels of education. The students' levels of hearing loss have to be carefully examined before deciding on any placements in mainstream or deaf bilingual schools. He has stated that places with few individuals with DHI and insufficient resources use the mainstreaming model as a temporary alternative, which is likely to have implications regarding the education of students with DHI (Komesaroff, 2005).

The role of ICT in supporting mainstreaming has been deemed to be positive by studies which have reported that ICT enable students with SEN and DHI to fully participate in learning, support communication in their environment with educators, peers and parents, allow self-expression where they can have a voice inside and outside classrooms, access learning materials faster, easier, cheaper and more effectively, in digital formats, record and track their educational developments and enable teachers to assess students' learning in new formats (Douglas, 2001; Bishop, 2003; Nevile & Treviranus, 2010; Mavrou et al., 2010; Bain & Parkes, 2006).

One of the most important ICT tools is frequency modulated (FM) technology for supporting the inclusion of students with DHI in mainstream schools. The FM system works with a transmitter device, placed at or near the location of a sound source. The FM device includes a wireless receiver, which sends sound signals to the hearing aids of the users. Finally, a transmitter enables users to hear the signal in electronic format (Boothroyd, 2004). An FM system prevents the reverberation and echo effects and eliminates outside sounds, such as classroom noise, traffic, car engines and so on. It has been used extensively in mainstream classrooms (Thibodeau, 2010). Lewis et al (2004) found that FM system improved the speech acquisition skills of students with DHI. Similarly, Thibodeau (2010) acknowledged that the FM system provided clearer and louder speech, and it was easier for the user to distinguish sound patterns. In addition, Sanford and Kierkhaefer (2002) investigated FM system effectiveness where users tried them for five weeks, and reported improvements with hearing in lectures and meetings and in public areas such as restaurants. Other studies investigated FM usage in classroom environments reported that FM use helps significantly in eliminating classroom noise, providing better sound signals, enabling teachers to move in the classroom without considering distance considering that FM works at a 15 to 25 meters distance between speaker and receiver (Lewis et al., 2006; Bones & Diggory, 2013).

Socio-Cognitive Outcomes of ICT for Students

Social Participation

ICT have a potential to affect the social participation skills of students by supporting the social participation through interacting with various ICT formats, including social media tools, chat rooms, web-portals, videoconferencing and teleconferencing and online electronic communication tools (Lee & Tsai, 2013). Barczyk and Duncan (2013) explained that digital tools such as video and photo editors help to prepare the content of individual cases (personal information or knowledge or documents), which can be quickly shared by a large number of people. In addition, web applications provide an interaction network and simultaneous joint participation features, where students may participate. Similarly, Pedro and Francesco (2012) suggested that students could create profile pages and group pages, such as profile pages, and share personal or private information about people or events that are of interest to the users or part of their social network. Students can organise online groups in private, and use open or hidden formats according to the purpose of work around a topic. There are many advantages of ICT reported in this respect. In conclusion, many studies reported that ICT provide opportunities for social participation; however, the effectiveness of this depends on the students' social and technology skills and the purpose of ICT usage (Valk, Rashid & Elder, 2010). Similar results were found in students with DHI in studies by Albertini, Kelly, and Matchett (2012), Pham (2007) and Braswell and Burris (2010). For instance, computerized games were found to encourage social participation of students with DHI in learning processes in an environment of healthy competition, where they could avoid the dangers of the Internet. For teachers, collecting, reviewing, tracking and providing immediate feedback on students' tasks is becoming faster, more affordable and easier to transfer into different digital formats for later use or to deliver to the authorities or the families of the students (Pham, 2007).

Cognitive outcomes of ICT for students with DHI

It is of crucial importance to emphasize the visual needs of students with DHI in accessing information and comprehending various during learning. Marschark et al. (2013) indicated that supporting the visual communication with visual media aids such as charts, tables, pictures, sign language videos, animations, graphs and other possible materials should be carefully examined and put into practice to compensate for hearing loss. A wide range of ICT has been reported in the literature to support the cognitive development of students with DHI. In a study by Banner (2005) it has been suggested that educational games based on ICT support cognitive development by enhancing imagination, creating links between symbols and taught objects, organizing logical thoughts, comprehending the principles of the games, generating specific hypothesis and testing them in reality, learning new ways of dealing with different tasks, and exploring various different perspectives and ideas of others to achieve the same goal. Similarly, regarding language development through ICT, Pham (2007)

suggested that computerized educational games enable students with DHI to better concentrate on grammatical patterns, vocabulary development, comprehending particular structures of the languages and pronunciation.

As the literature suggests, most students with DHI are visual learners because of their reliance on vision on learning and language, including sign language and speech reading (Convertino, Sapere, Marschark, Sarchet & Zupan, 2009). Marschark et al. (2013) argued that any ICT that support visualising learning subjects would be of some value. This support has been suggested as making a crucial contribution to developing better comprehension for students with DHI in terms of establishing links between subjects and students' imagination (Li, 2007; Zaharudin, 2011a). Li (2007) indicated that students use ICT to describe and organise ideas, order them in a logical sequences, explore relationships between ideas such as cause and effect, visualise their perceptions to solve problems or develop new understanding about various subjects. In another study, Enns (2009) suggested that ICT support visualising relationships between different data and values such as software programmes, in which comprehension skills for students with DHI may be developed.

Visualising with ICT also help students with DHI to create information products to support their comprehension skills such as capturing and saving images, classroom notes, and editing and manipulating information products in a way that they understand better (Enns, 2009). Giddens (2009) further pointed out that the visualising features of ICT enable students to design a bank of digital information based on their own learning, such as notes, multimedia, recordings, and digital materials. This in return helps them to manage information and retrieve data when needed for the purposes of enhancing the comprehension.

Vocabulary Development

ICT tools have been reported to develop vocabulary learning skills for students with DHI through a diverse combination of animations, pictures, graphics, and videos enhanced by sign language (Gentry, Chinn & Moulton, 2005; Gentry et al., 2004). In one study, Loeterman et al. (2002) created a program called Cornerstones to develop the vocabulary skills of students with DHI. It found that by using written stories enhanced with multimedia tools, the students outperformed in evaluation tests compared to the control group who did not study by multimedia tools. Similarly, a program called See and See was employed in a school for students with DHI. This project offered evidence that students learned vocabularies better when they were supported by visual aids such as Greek Sign Language videos and corresponding pictures (Nikolaraizi & Vekiri, 2011). In addition, a study by Guzel (2015) investigated a program called "multimedia builder" in a primary school for students with DHI in Turkey. This program combines picture, sign language and audio components of the same vocabulary item and allows students with DHI to simultaneously learn visuals (picture and sign language) and parallel audio/sound components of the item in question. The findings suggest that students learn vocabulary faster and better with this program compared to traditional learning based on a paper format.

Cognitive Effects of Audio-Visual Information Transferring through ICT

Communicating in audio and visual formats simultaneously has been effective in improving the cognitive skills of students with DHI. Baskent and Bazo (2011) pointed out that using appropriately aligned audio-visual information for hearing aids users is important in transferring knowledge, because auditory signals are destroyed, they are heavily dependent on visual cues. In support of this, Jesse and Massaro (2010) have demonstrated that recognizing speech is more effective when listeners can simultaneously see and hear a speaker talk, rather than only seeing or hearing separately. This is because audiovisual materials generate complementary information regarding speech segments and listening to a speaker. This is referred to as intermodal synchrony (relating to more than one mode of transport) (Liu & Sato, 2009; Desai, Stickney & Zeng, 2008). There are also possible disadvantages in using hearing devices, because the signal processing may be delayed, and also, there may be asynchrony between audio and visual cues in telecommunications materials.

In addition to the above, the sensitivity of audiovisual asynchrony can be affected proportionally with the degree of hearing loss (Baskent & Bazo, 2011). In general, studies suggest that students with moderate hearing loss are more likely to make use of auditory information, compared to students with severe to profound hearing loss (Bergerson et al., 2003; Schorr, Fox, Wassenhove & Knudsen, 2005; Kral, 2007). However, caution must be applied insofar as some studies have found evidence that students with severe hearing loss made better use of residual hearing in auditory speech comprehension, compared to students with moderate hearing loss (Liu & Sato, 2009). The reasons to explain this are age of onset in hearing device use (Watson, Archbold & Nikolopoulos, 2006) and the quality of auditory education received and the quality of hearing devices (Baskent & Bazo, 2011). Therefore, some students with DHI might have different auditory speech perception skills irrespective of the degree of hearing loss (Gordon, Papsin & Harrison, 2003; Kral, 2007).

Mitchell and Maslin (2007) claimed that when the visual cues are constantly used by students with DHI, there might be some functional changes such as cortical reorganization, improved perception of motion and peripheral stimuli in the brain. Research studies supported this by stating that in the presence of combined audio-visual information in tests of spoken language perception, the achievement was better compared to audio and visual alone conditions for students with DHI (Geers, Brenner & Davidson, 2003; Lachs, Pisoni & Kirk, 2001; Massaro & Light, 2004; Wu et al., 2007; Jesse & Massaro, 2010). The audio-visual speech perceptions of students with DHI were studied by Lachs et al. (2001) by administering an open-set sentence comprehension test in order to measure the conditions under which students with DHI were more successful. The performance of the students was better in conditions where speech was presented in an audio-visual format, compared to audio-alone and visual-alone modes. Also, they reported similar outcomes, and almost no difference between audio-alone and visual-alone implementation. Students with DHI were found to demonstrate multisensory development depending on

the presentation channel of information. However, it was found that the effective performance of the students on audio-visual presentations was correlated to the performance of audio-alone in terms of spoken word recognition and the production of diverse speech competences. Those students who were successful in audio-visual tests also demonstrated good skills in these competences, which suggests that "the ability to comprehend audio-visual inputs is not isolated or independent from other speech and language skills but may reflect common properties of the language processing system itself " (Lachs et al., 2001, pg. 7).

Massaro and Light (2004) conducted a study to integrate a computer-animated 'talking head', known as Baldi, in a secondary school for 8-13 years old students with congenital moderate-to-profound hearing loss. They were trained in single consonant and consonant clusters, and were provided with concurrent speech therapy by Baldi. Implementing Baldi took 21 weeks, 6 hours of training per week. Pre- and post-tests were employed, and examiners rated the intelligibility of productions of students' individual utterances against the target text. The results showed significant improvements in the speech producing skills of students with DHI.

Similarly, Wu et al. (2007) employed a computer-based auditory training program to improve the vowel, consonant and tone recognition of students with HI. 10 students aged 5-10 years participated. Firstly, the baseline recognition skills (vowel, consonant and tone) of the participants were measured. Then, a computer program was employed 30 minutes per day for 5 days during 10 weeks of implementation period, with the students listening to a large number of monosyllabic words. The student with HI demonstrated significant improvements in all parameters (vowel, consonant and tone) compared to the baseline results. Some of the students showed better skills in vowel recognition, and others in consonant recognition. However, 6 out of 10 students showed overall improvements in all three conditions.

ICT Facilitative and Hindering Factors in implementing ICT

The use of ICT in education has been an important topic of discussion among researchers and educators for over thirty years (Lowher, Strahl, Inan & Ross, 2008). A large number of studies have been published investigating effective strategies and availability of resources to support ICT integration in education. Most of these focus on promoting ICT use to break down the barriers that administrations, schools and teachers encounter during the education process (Petko, 2012). The barriers in ICT implementation are defined as any specific or general issues that prevent anyone in education from benefiting from ICT opportunities (Gillespie, 2006). It is important to identify the barriers in ICT implementation in order to intervene and overcome these barriers (Nikolopoulou & Gialamas, 2013).

Several research studies have analysed the integration process of ICT in education and reported barriers. In general, these barriers include ICT usability, flexibility, affordability, accessibility issues, lack of infrastructure, inadequate teacher training opportunities, lack of confidence and motivation,

insufficient ICT knowledge skills, lack of administrative support, teachers' and principals' attitudes towards ICT, lack of pedagogical adjustment and belief, and poor fit with the curriculum (UNESCO, 2013; Agyei & Voogt, 2011; Georgina & Hosford, 2009; Prestridge, 2012; Han, 2008; Ihmeideh, 2009; Nikolopoulou & Gialamas, 2013; Richardson, 2011; Salehi & Salehi, 2012).

UNESCO (2013) reported that ICT should be carefully planned and designed according to following themes.

Usability: In order to increase the usability of ICT, an educational ICT platform should include functions such as basic navigation to the required content, guidelines for content, inter-operation with other AT materials and devices, easy log-on and menu options, tracking students user performances and records. With these components, ICT usage should be simple for teachers and other educators in order to improve ICT' effectiveness. It is also reported as important that if ICT are complicated to use, they are most likely not going to be used by educators (Agyei & Voogt, 2011). Hence, usability features of ICT should be carefully designed (Georgina & Hosford, 2009).

Accessibility: All individuals regardless of their physical or mental abilities should be supported by the use of ICT in education, as this has been established in many countries as legal frameworks. The key point here is that ICT must provide information and must be tailored to the various needs of students in general, and with SEN, so they can take equal advantage from ICT without leaving any of the students out of education cycle (Prestridge, 2012; Han, 2008).

Flexibility: Designers first implement their ICT products and then if it is necessary, they may redesign them by equipping them with the latest available alternatives to create the best products. Therefore, technological devices may rapidly change in today's schools. In this respect, ICT platforms should have the capacity of integrating and altering with new advanced technological materials when necessary. Teachers should be able to access educational ICT materials from the widest possible range of available ICT tools. Also, they should customize their own operating style that is suitable to their work environment and way of learning. Curriculum and course designers should easily adopt core teaching materials to the special needs of students, such as the necessary software or hardware to run teaching applications (Ihmeideh, 2009; Nikolopoulou & Gialamas, 2013).

Affordability: ICT resources that schools and individuals' use for their variety of needs will inevitably bring a financial burden. It is a fact that people with SEN often have low incomes, and may not readily afford to buy necessary ICT (Richardson, 2011). Therefore, the lack of income should be abolished by educational agencies, health care services, or other related agencies so as not to exclude those who could need ICT the most (Richardson, 2011).

Cost: One big concern among educators and policy makers is the high cost of ICT in education. To consider ICT implementation as successful in education, it should provide fast, reliable and low cost

communication environment. When it comes to equipping student with SEN with ICT, rapidly developing new high-tech devices and software programmes may require additional financing. Also, cost issues may vary depending on the students' specific health needs, since some of the students with SEN may need extra health support such as students with deafness or hearing impairment, autism and learning disabilities (Salehi & Salehi, 2012; UNESCO, 2013).

The availability of ICT infrastructure plays a crucial role in providing the necessary opportunities for anyone in education to benefit from ICT. There have been significant ICT developments regarding in schools and students in the last decade (Saheli & Saheli, 2012). However, several studies have reported that lack of infrastructure, limited access to software and hardware programmes, and low connectivity are still important barriers to ICT integrations in the education process around the world (Neyland, 2011; Richardson, 2011; Brill & Galloway, 2007). In Turkey, various studies investigating this issue have concluded that the availability of ICT has been a problem for schools in general (Celik & Yesilyurt, 2013); however, it is worse for special education schools (Aslan & Zhu, 2016). There is a need for ICT software programmes specifically designed for the specific needs of students with SEN and students with DHI (Unluer, 2011). The lack of specifically designed ICT to teach Turkish Language (TL) has also been reported as a hindering factor in ICT use in the literature. Sari (2013) suggested that the number of ICT resources used to teach TL was quite limited in Turkish special education schools for students with DHI. This in turn was reported to negatively affect ICT implementation in classrooms. In particular, ICT such as computer software programmes and educative videos based on visual teaching of TL components such as grammar and syntax have been reported as being insufficient (Kubus, 2008).

The use of ICT in classroom is directly influenced by the teachers' digital competences (Valiente, 2010). Teachers play the most important role in employing ICT in practice in actual teaching and learning environments. Hence, it is important for teachers to be able to demonstrate ICT knowledge and skills. The literature found that the digital ICT competences of teachers are a potential barrier to ICT application in education (Ihmeideh, 2009; Oye et al., 2011). There have been several hindering factors reported by the literature as teachers lack ICT knowledge and skills, including software use, digital material design, computer applications management, making proper use of digital resources, operating different teaching and learning tools based on technology etc. (Kreijns, Acker, Vermeulen & Buuren, 2013; Hutchison & Reinking, 2011). Turkish teachers' ICT competences were found to be a hindering factor in ICT application in schools. Several studies (Onder, Celik & Sılay, 2011; Isciturk, 2012; Goktas, Yildirim & Yildirim, 2009; Goktas, 2006) found that Turkish teachers' ICT knowledge and competences were insufficient to employ ICT in teaching and learning. Turkish special education teachers' ICT knowledge and skills were also investigated by Girgin (2011) who agreed they are hindering factors in ICT use.

The attitudes and beliefs of teachers and principals may be both facilitative and hindering factors in ICT use. The attitudes of teachers' are an essential factor in terms of whether the inclusion of ICT is productive in education (Sáez López, 2010; Teo & Noyes, 2011; Lan, 2012). The negative attitudes of teachers towards ICT may arise from the belief that ICT will not enhance learning or teaching, or by simply being more comfortable in the traditional model of teaching (Pierce & Ball, 2009). It is further stated that the ICT implementation process brings challenges to teachers and administrations; for instance teachers' enacted beliefs may not align with new ICT teaching materials (Berg, Benz, Lasley & Raisch, 1998). The reasons for the disharmony between beliefs and practices have been explained insofar as teachers might be required to use pre-determined curricular and assessment materials, which may not be consistent with their pedagogical beliefs (Ertmer, Gopalakrishnan & Ross, 2001). Similarly, regarding special education, Ravitz, Becker and Wong (2000) have suggested that because of the diversity of students' individual needs, trying to balance multiple teaching objectives with new ICT could be difficult for teachers to adopt.

Turkish teachers' attitudes and beliefs towards the use of ICT have been investigated by several researchers (Akkoyunlu, 1996; Altun, 2003; Asan, 2003; Cavas & Kesercioglu, 2003; Deniz, 2005; Gomleksiz, 2004; Goktas, Yildirim & Yildirim, 2009; Isciturk, 2012; Onder, Celik & Silay, 2011; Uluyol, 2013). In general, these studies have concluded that Turkish teachers' attitudes towards ICT use have shifted over time, becoming more positive. However, attitudes have remained one of the most reported barriers in ICT application in Turkish schools (Uluyol, 2013).

Insufficient teacher training was identified as a major hindrance in ICT application in schools by several studies (Georgina & Hosford, 2009; Yalin, Karadeniz & Sahin, 2007; Jimoyiannis & Komis, 2007; Teo, 2008; Yapici & Hevedanli, 2012). In these studies, teacher training was suggested as lacking not only technical underpinnings, but mostly instructional and pedagogical understanding in integrating ICT in teaching and learning (Puga, 2006; Thomas & Knezek, 2008; Somekh, 2008; Sang, Valcke, Braak, Tondeur & Zhu, 2011). Teachers' participation in professional development activities has made a significant contribution to teachers' ability to use ICT, the collaboration between professionals and teachers, being informed about available technologies, and achieving the necessary skills to apply in real classroom settings (Fredriksson et al., 2008; Bacigalupo & Cachia, 2011). Therefore, teachers should be regularly updated in the ethical and pedagogical aspects of ICT, since technology develops at a fast pace (Akbulut, Odabas & Kuzu, 2011).

Vision and leadership of educational professionals can influence technology integration in teaching and learning, hence leadership was found to be a facilitating factor in ICT integration in education (Mrazek, Hollingsworth & Street, 2005; Papaioannou & Charalambous, 2011). On the contrary, inadequate administrative support was identified as being an impediment to the integration of ICT in schools (Salehi & Salehi, 2012). Chigona et al. (2010) has also addressed the issues to emerge

during ICT integration in teaching and learning in general, concluding that school management policies and strategies should provide the necessary incentives for educators, improve ICT management, and encourage the implementation of computer laboratory activities for teachers and students.

The literature suggests that teachers' established pedagogical understandings of ICT could be a strong facilitative or hindering factor in ICT implementation (Ertmer, 2005; Kreijns, Acker, Vermeulen & Buuren, 2013). This understanding can be a 'collision' or 'collusion', both having implications for how ICT are used in education (Prestridge, 2007). Kreijns, Acker, Vermeulen and Buuren (2013) emphasized that pedagogical interventions could be supported by appropriate use of ICT in the education process by enabling educators to effectively deliver the curriculum in regard to today's computer advances in information delivery. To do so, it is necessary to train and sustain educators in general in terms of the appropriate adaptation of ICT resources and infrastructures to enable them to extensively understand and employ ICT in practice. However, ICT pedagogical outcomes are not necessarily viable in the short term; rather they are a continuous long-term process (Kreijns, Acker, Vermeulen & Buuren, 2013). Pedagogical beliefs are formed in several years of experiences and knowledge, therefore, they could be resistant to change (Keys, 2007). This resistance has been found in the literature, pointing out that the difficulties experienced in teachers' pedagogical understandings of ICT use are hindering in ICT application (Orlando, 2009; Loveless, Burton & Turvey, 2006; Mishra & Koehler, 2009). Likewise, Turkish teachers' long-standing pedagogical beliefs were found to be resistant to change (Uluyol, 2013; Yucel, Acun, Tarman & Mete, 2010) affecting the extent to which ICT has been integrated in Turkish schools.

The lack of support from MONE has been seen as a crucial hindering factor in Turkish schools by several studies concerning the Turkish context (Basturk, 2005; Aydin & Gürol, 2016; Akbulut, 2010; Aydin, Güclü & Pisapia, 2015). In a study by Cakir and Yildirim (2013), ICT support of MONE was reported to be insufficient by teachers and similar results were found in other studies (Cakiroglu, 2015; Demiraslan & Usluel, 2008; Goktas, Yildirim & Yildirim, 2009). One of the issues reported was lack of infrastructure for special education schools (Sari, 2013). Even though the MONE have utilised computers and smart boards for all special education schools around the country between 2012 and 2015 as a part of national project called "FATIH", the number of materials designed for students with DHI has been insufficient (Karal, 2015). Especially digital materials supported by visuals and sign language videos have been poorly provided by MONE and some studies showed that special education teachers have never received such materials in Turkish schools (Goktas, Yildirim & Yildirim, 2009; Sari, 2013).

Sari, (2013) indicated that Turkish special education teachers might outsource ICT educative tools considering the lack of MONE material support. Schools outsource ICT from private companies who produce ICT for supporting teaching and learning as well as online resources. Studies have argued

about the positive and negative effects of outsourcing. Powell (2015) demonstrated that teachers valued outsourcing, because it provided teaching and learning materials that utilise diverse learning channels for students. Similarly, principals regarded outsourcing helpful for teachers and students by addressing various academic aspects of education such as reading, writing, speaking and listening (Powell, 2015). In contrast, some studies reported possible risks of outsourcing ICT as Ball and Youdell (2007) argued that private companies often seek profit and create products based on this logic that they may try to shape educational practices accordingly with their own aims for further financial profits. For instance, the same products are usually reproduced each year with extra features and costumers are psychologically pressured to buy them based on the idea of following up-to-date and better-developed ICT in education. Burch (2009) has further suggested that private sector ICT developers seek profit referred to as 'bang for their buck' (Burch, 2009, pg. 7). Therefore, this mentality could be the main factor in producing some ICT, rather than addressing the educational needs of students. In support of this, Petrie et al. (2014) suggested that ICT producers might have insufficient expertise or content knowledge about students' educational needs.

Curriculum and Students with DHI

There are numerous definitions of curriculum as a system of structuring any learning environment in a specifically planned and guided way (Kelly, 1983). Bohman (2012) names and categorizes some of the curricula according to their features such as the internal curriculum which refers to the mental skills, knowledge, individual experiences and specific talents of the students. The societal curriculum covers the areas of taught subjects by the society and the concomitant curriculum associated with the family involvement of the teaching subjects at home and in any location that is connected to the family participation.

There have been a long-standing debate about what to teach to students with SEN including students with DHI, whether the same or differentiated-individualised curricula (Ryndak, Jackson & White, 2013). On the one hand, a student with SEN should be taught within a general curriculum to acquire the academic skills appropriate for a certain age and grade level of a typically developing student. On the other hand, an alternative curriculum is advocated tailored to the particular academic levels of students with SEN (Shurr & Bouck, 2013). According to Bouck (2012), the first approach has been in practice in most countries and implementation of differentiated curricula has been rarely used (if any). However, several research studies suggested that special education teachers and students with SEN regarded the general curriculum as something difficult to access in special education contexts (Ayres, Lowrey, Douglas & Sievers, 2011; Browder, Wakeman, Flowers, Rickelman, Pugalee & Karvonen, 2007; Clayton, Burdge, Denham, Kleinert & Kearns, 2006; Wehmeyer, 2006). This is also a case in the education of students with DHI (Bailey, Angell & Stoner, 2011; Unluer 2011; Shadiev, 2013). In conclusion, the problems with the general curriculum were stated as design problems, being designed for

an optimum academic development of typical students and inevitably lacking the specific academic requirements of students with SEN. For instance, the academic levels of students with intellectual problems, students with DHI, autism, dyslexia, cerebral palsy have been reported as being behind than those of their typically developing peers in terms of academic skills in reading, writing, listening and speaking (Antia, 2009; Browder et al., 2007; Ryndak et al., 2010). The second problem regarding the application of a general curriculum is the forms of assessment. Giangreco et al. (2011) concluded that teachers largely employ testing protocols that are aligned with assessing general education students' functional skills in academic and social forms. They miss two crucial principles regarding the assessment of students with SEN: individualisation and applied behaviour analytic strategies (Browder, 1991). Students with SEN are expected to demonstrate progress in grade and age- appropriate curriculum with the same standardised assessment protocols, however, considering research findings, this aim has been rarely achieved and mostly failed (Wehmeyer, Lattin, Lapp-Rincker & Agran, 2003; Restorff & Abery, 2013; Yeo, 2010).

Similar problems were reported in the Turkish context where a standardised general curriculum has been in practice over decades in special education schools and an individualised curriculum has never existed in Turkey (Melekoglu, Cakiroglu & Malmgren, 2009). This applies to the education of students with DHI as the rule stated in the Turkish Special Education Constitution which stipulates that students with DHI can learn the same materials as their hearing peers in terms of academic achievements (ÖGM, 2002). However, in reality, hearing loss inevitably decreases the listening and speaking acquisition skills of students with DHI that in return negatively affects their academic performances (Antia, 2009; Schick, Williams & Kupermintz, 2006). Hence, these students could not properly benefit out of standardised curriculum as Marschark (2015) suggested we should not expect equal academic achievements under this circumstances. In Turkish contexts, research studies offered individualised curriculum, or modifying existing curriculum with adding new curricular interventions addressing the academic needs of students with DHI (Sari, 2013; Unluer, 2011). For instance, assessment tools should be modified to include sign instructions, extra time in exams should be provided, and the language and academic levels of books should be simplified. According to Cavkaytar (2006), in this process, the aim of curriculum modification should be carefully organized and must preserve the necessary skills and knowledge at the higher academic standards aligned with academic achievements of students with DHI.

A brief history of Turkish Sign Language (TSL)

TSL is the main, and only sign language used by the Turkish deaf community throughout the country. Its roots are believed to go back around 500 years, owing to evidence that the deaf people were employed in the Sultan's court and assigned with different missions starting from 1500 until 1900 (Miles, 2000; Kubus, 2012). There is no evidence as to whether the sign language used earlier was related to TSL (Gökgöz, 2011). However, according to Zeshan (2003), today's TSL number system from 6 to 9 is the

same as the Arabic written numbers (one of the official language of Ottoman Empire). Therefore, there is a small possibility that TSL could be partly derived from Ottoman Sign Language (OSL). However, there is not enough evidence to prove this connection (Arik, 2009). In 1902, the first deaf school was established in Turkey. It used OSL and official Sign Language training was started (Ozyurek et al., 2004). It operated until 1928, when the new Turkish Alphabet with Latin characters officially begun to be used. Therefore, changes in the manual alphabet of TSL occurred (Arik, 2009). However, researchers found that despite the alphabet change, we may still use some signs from OSL because as Kubus (2008) explains, "signed languages do not have strong commonalities with their ambient spoken languages in terms of lexical and grammatical usage" (pg. 51).

The use of TSL in Turkish Schools was forbidden in 1953 in Turkey (Zeshan, 2003). The purpose was to encourage oral language use and an Oralist approach was enforced throughout the country by the MONE (Ozyurek et al., 2004). This inevitably had a significant effect on the Deaf community, from where opposition emerged (Zeshan, 2003). The rule forbidded TSL use was thought to be against the human rights and freedom of language preference for the Deaf (sign or oral language). Despite protests, this rule has been in practice from 1953 to present (Arik, 2015). There have been some interventions such as the Act of Disability in July 2005, where the MONE acknowledged the use of TSL in schools as supporting the communication skills of individuals with DHI. However, it did not allow TSL to be used as an official language in schools (Arik, 2015). Since 2005, TSL awareness and research on this matter has increased, and courses teaching TSL emerged in Turkey. However, because TSL is not recognized as an official language to be used by people with DHI in Turkish schools, the tension still exists among the supporters of TSL and the MONE (Kubus, 2008; Arik, 2015). According to Ozyurek et al. 2004 and Arik (2015), TSL was being used by the Deaf all the time from 1953 to 2015 among the deaf outside of schools. Private institutions such as rehabilitation centres, a few private schools' TSL courses were in action to teach TSL to keep it alive and pass it to the next generation. Similarly, Deaf people used TSL among each other, mostly outside of schools, and passed on TSL knowledge to the others.

Because of prohibiting TSL use in schools, another big issue emerged, as Arik (2012) has explained, namely that the studies concerning TSL development have lacked any investigation of its features compared to the other sign languages around the world. Professional studies to develop better TSL usages began in early 2000s (Arik, 2009; Ozyurek et al., 2004; Zeshan, 2003).

The Structure of TL and How ICT and TSL Responds to It

It is important to understand the structure of TL in order to understand how ICT and TSL could respond to it. TL is a member of the Altaic language family, and has 29 letters in Latin characters, consisting of 8 vowels and 21 consonants. It is "an agglutinative language with word structures formed by productive affixations of derivational and inflectional suffixes to root words" (Oflazer, 1994). It is

possible to generate a significantly high number of words from the same root with suffixes. A popular but rather exaggerated example to explain Turkish Word formation was stated as:

OSMANLiLASTIRAMAYABiLECEKLERiMiZDENMiSSiNiZCESiNE.

This is one word and its morphemes are OSMAN+LI+LAS+TIR-AMA+Y+ABiL+ECEK +LER+iMiZ+DEN+MiS+SiNiZ+CESiNE.

The +'s demonstrates morpheme boundaries. The translation of this word into English is "(behaving) as if you were of those whom we might consider not converting into an Ottoman" (Oflazer, 1994, pg. 3).

Turkish has complex morphotactics, whereby "morphemes added to a root word or a stem can convert the word from a nominal to a verbal structure or vice-versa, or can create adverbial constructs as above" (Oflazer, 1994, pg. 3). Therefore, the Turkish language allows for the formation of words, which may change several times during affixation. For instance, it is possible to start with a nominal root and form a verbal form with a suffix, then by a gerund suffix, it becomes a nominal form again. It can further take the standard nominal suffixes such as plural or possessives (Kubus, 2008; Oflazer, 1994). Such a formation is also restricted by semantic restriction, because it is technically possible to form a word with many suffixes but it has to make sense. In terms of the phonological aspects, phonetic rules demonstrate diverse features such as "vowels in the affixed morpheme have to agree with the preceding vowel in certain aspects to achieve vowel harmony" (Oflazer, 1994, pg. 3), vowels and consonants in the root words or morphemes have to be deleted in some situations (Hankamer, 1986), and word formations depending on the assimilation of a number of words entered into Turkish mainly from Arabic and Persian languages (Solak & Oflazer, 1993).

The literature review suggests that ICT is insufficient in teaching Turkish language components to students with DHI. In a study by Sari (2013), Turkish primary school teachers of students with DHI reported that the number of available ICT in software formats was quite limited. Available ICT were mostly videos, including animations and cartoons to teach very basics of TL such as grammatical rules, significantly lacking in teaching morphology and phonology of TL. The literature pointed out that most of the available ICT are designed accordingly with typical students' learning requirements, which may not always address the specific needs of students with DHI, including better sound components supported by visual materials (Gulbahar & Guven, 2008). The findings also indicated that visual materials (as a part of ICT) were largely based on paper-based formats, which were not new or interesting for students with DHI (Gulbahar & Guven, 2008). Rather, they need to provide ICT to teach morphological and phonological concepts of TL with optimum sound quality, and supported by visual cues (e.g. sign language).

In the literature, there have been reports of some problems with the use of TSL in teaching TL components (Zeshan, 2003; Kubus, 2008; Arik, 2013). Kubus, 2008 suggests that both languages have different modality features in grammatical, phonological and morphological features, as the table below shows.

Table-24 Modality difference between Turkish and Turkish Sign Language (TİD)

Modality difference	
Turkish (Spoken Language)	**TİD (Sign Language)**
Audio-vocal (aural-oral)	Visio-spatial
Sounds (consonant – vowel)	Signs (Handshape, Hand Orientation, Movement and Location)
No use of space	Signing space
Mainly sequential	Simultaneous & Sequential
Arbitrary lexicon (with rare exceptions)	Arbitrary lexical (but also some iconicity)
No classifier use	Rich use of classifiers
Poly-morphemic and poly-syllabic	Poly-morphemic but monosyllabic
Many suffixes among them morphological case	No suffixes (some exceptions) but rich morphological processes
Tense suffixes	No tense, instead use of aspect and use of temporal adverbs
S-V agreement	S & O –V agreement

Table 1. Modality difference between Turkish and Turkish Sign Language (TSL or TID as stated in the table).

As the table demonstrates, TL and TSL (as stated TID in the table) portray different modalities and features. One of the major differences lies in morphology and phonology. For instance, TL is an agglutinative language with a large number of derivational and inflectional suffixes, while TSL has no signing features for suffixes. Similarly, TL has tense suffixes, where TSL has no tense option except use of temporal adverbs. It is reasonable to have such differences in both different languages as Zeshan (2003) describes. The main issue here is signing (with TSL) derivational suffixes in TL, which is extremely difficult, and in some circumstances, impractical (Zeshan, 2003). In another study about TSL, Zwitserlood, Perniss and Ozyurek (2012) found that TSL does not "exhibit productive morphological expressions of multiple entities" means that TSL largely lacks generating morphological plural marking (i.e. reduplication) on nouns, numerals and quantifiers (Zwitserlood, Perniss & Ozyurek, 2012, pg. 11). In terms of affixation that creates a different form of a word or a new word by adding a morpheme (affix) to a word, the same study indicated that making use of affixation in TSL is significantly limited. In conclusion, as the studies show, TSL and TL exhibit quite different linguistic differences that is seen as a typical phenomenon in other languages, as well in American Sign Language (Padden, 1998) or in German

Sign Language (Pernis, 2007). However, the main issue is the lack of TSL features to properly sign the linguistic specifics of TL, as reported in the literature. This in return causes crucial communication problems amongst students with DHI and teachers in the education process in Turkey (Özyürek, Zwitserlood & Perniss, 2010; Kubus, 2008). Studies with similar problems between the languages and corresponding sign languages (SL) suggested in general that more practices, strategies and possible technological supports should be integrated in developing SL, especially in alignment with more visual inputs in signing linguistic features of the languages (Pizzuto & Corazza, 1996; Reistma, 2008; Zeshan, 2003; Pernis, 2007).

Speech Recognition Technology

New ICT devices have brought several new teaching opportunities for all learners. One of them is speech recognition (SR) technology, also known as speech to text (STR), which provides new learning technique by synchronizing captions and transcripts of live and recorded speech (Bain, Basson, Faisman, & Konecsky, 2005). SR technology translates speech inputs into text in real-time that involves a speaker speaking into a microphone, wherein the speech is recognized and shown synchronously in the form of a text for readers on a whiteboard or computer screen. A computer keyboard may be utilized during this process to change a word or phrase not recognized or recognized incorrectly (Wald & Bain, 2008; Aylesworth, 2005; Way et al., 2008).

The available products that provide speech recognition that have been significantly developed over the last decades can be used for a numerous different purposes (Shadiev, 2016). For instance, captioning video, voice controlled computer operations, dictation and hand-free written tasks with SR applications. Some of the products can be used by only one user, while others are able to be used by multiple speakers. The most frequently used voice to text products are Caption MicTM, Nuance-Dragon Naturally SpeakingTM and Dragon Dictate for Mac, iCommunicatorTM, Video Remote Interpreter, CART (communication access real time captioning), and CPrint. The Dragon Naturally SpeakingTM is one of the most widely used and popular speech recognition programmes in English for last 20 years (Ranchal et al., 2013). Besides, ICommunicatorTM is a multifunctional product that converts speech into text, speech into sign language or computer-generated voice.

Among these speech recognition programmes, the only developed and used Turkish speech recognition program is called "Dikte", which has the functions of converting speech into text, text into speech, and controlling the computer by dictating word/voice orders and sound recording.

A sound card and microphone are the required items, with specific brands and models being used depending on SR software. The microphone is used to capture the user's speech, while the sound card converts them into a digital form that the SR software can interpret (Wald, 2010). User profiles are created by SR programmes, allowing users to complete a training exercise where specific sentences and

words are asked to be spoken into the software (see picture 3). It is then used to compare spoken words with the users' profiles, in order for "the software to determine which words the user probably spoke" (Ranchal et al., 2013). Another strategy that SR software employs is to use a general user profile that is based on the speeches of a number of people (depending on the SR software) and grammar rules.

Among the most commercially developed SR software, dictation with punctuation is the most used system, rather than "transcribing extemporaneous speech which is structurally and grammatically different from written prose" (Ranchal et al., 2013). One of the reasons for this is the difficulty of reading transcripts that are an unbroken stream of texts without punctuation and formatting (Wald & Bain, 2008). SR programmes have the functions of dictating or giving word comments into the computer by demonstrating different functionality, capability and ease of use features. In general, most of STR programmes offer editing by word/voice commands including:

. "Select", "select next/previous"

. "Delete" , "Delete Next/Previous"

- . "Capitalize" , "Capitalize Next/Previous"
- "Lowercase" , "Lowercase Next/Previous"
- "Uppercase" , "Uppercase Next/Previous".

In terms of punctuation, voice commands include:

- "Put Quotes Around <text> "
- "Put Parentheses Around <text> "
- "Put Brackets Around <text> "
- "Put Comma"
- "Put Dot" and more.

Voice shortcuts for search include commands such as "search Google for X" or "search Mac/PC for 'basketball techniques paper'". There are many more features, including Proofreading (selected texts read out loud to the users), MouseGrid function where the placement of the cursor (mouse click and movement) can be directed with voice/word commands and creating new voice commands to control computer applications or setting up voice-triggered works, such as opening/closing different applications etc.

The Usage of SR in Education

Research studies over the past decade have provided important information in regard to the potential of SR, which has become a valuable tool to provide better accessible and understandable

teachings to all students (Wald, 2010; Shadiev, Hwang & Huang, 2013; Konur, 2007; Fichten et al., 2000; Wald & Bain, 2008; Nisbet & Wilson, 2002; Nisbet, Wilson & Aitken, 2005). SR have been applied in several fields of education, including mainstream schools and for foreign/non native students, for students with learning and physical problems (cerebral palsy, apraxia, visual impairments), students with dyslexia, hearing impairment, reading, writing and spelling difficulties.

Studies investigated the SR application in general education classrooms for typical students without any disabilities, and reported important educational outcomes. Ryba et al. (2006) analysed the benefits of the SR application on native and non-native speakers of English in university lectures. SR transcripts were displayed on a whiteboard, along with providing edited texts after the lectures. The responses of 160 participants showed that the SR had potential as an instructional support mechanism. SR texts were reported by non-native speakers to be useful to understand and clarify lecture content and better follow the instructors. Native speakers emphasized that the SR texts were more useful for them to study later in exams or in homework.

In a similar fashion, Shadiev et al. (2013) investigated the SR effectiveness for non-native English speakers of graduate students. The SR transcriptions of the lecture were provided simultaneously on a whiteboard, and after the lectures as texts. Most participants reported that the SR texts were supportive of learning the lecture content, along with providing well-taken lecture notes. Better accuracy rates for SR were required to improve the effectiveness of the texts, and several methods for making better use of them were identified. Shadiev et al. (2013) conducted another study where SR was applied to graduate and undergraduate non-native English speakers and compared the participants' perceptions regarding the usefulness of SR texts for learning. SR effectiveness on the students' learning achievements was investigated. Also, the visual attention and learning behaviours of the participants such as learning style preferences and gender were compared. The visual attention of the participants was detected by using eye-tracking software (SMI iView X RED), which explained the participants' attention distribution to different areas of interest, such as videos of the instructor, SR text and slides of the lecture. The specific strategies were applied as called fixation count (the number of fixation points in a zone), fixation frequency (the number of fixation occurrences on one particular area of interest) and the percentage of fixation duration (the total fixation duration divided by the total time the SR text were shown on the whiteboard). The same SR application process of transcribing speech of the lecturers' into texts format and displaying on a whiteboard was employed. The results from twenty-one participants showed that they relied on the SR texts more than watching the instructors and lecture slides. Participants with low-level English skills reported better development in learning performance compared to the high level ones. The SR texts were useful in learning development, regardless of the levels of the participants' English levels, or their learning preferences and gender differences. However, differences were found between students, such as in some participants with low listening skills of English but with good reading skills.

The participants pointed out that reading the SR texts was more helpful for them to understand lecture content better, compared to only listening to the instructor, because, based on their low level of English skills, there were inevitable information miss from listening. Also, it was reported that the SR texts supported some of the participants "to locate some words that they did not know in aural form but could easily understand them in written form" (Shadiev et al., 2014, pg. 3).

Goddart et al. (2007) conducted a study by employing a SR system in classroom to support students' learning skills in primary school. Each participant created a user profile and trained the SR system to record their own voices for a while, which enabled the SR system to better transcribe users' speech. The users were provided with texts of their speech, and the SR system also played back the students' audio recordings. The results showed that the SR was an effective tool in developing better pronunciation skills and a sound training system for primary level students. Receiving instant feedback and trying to correct the mistakes were reported to provide significant support for language development. The students were also required to edit the SR texts (after the class) if incorrect transcriptions occurred by listening to their own audio recordings. This was suggested to be effective in developing better writing, listening and editing features for the students.

The Application of SR in Special Education

According to evidence from research, conveying information in class is still mostly done through audio channels (Huang & Chiu, 2014; Camiciottoli, 2005). This means that there are some challenges for students with learning and physical problems such as cerebral palsy, apraxia, visual impairments, students with dyslexia, hearing impairment, reading, writing and spelling difficulties and especially those struggle with note taking in terms of understanding the content (Lee, 2011; Miller, 2007; Wald, 2011). In this respect, assistive technologies are reported to provide solutions when adopted in an education process such as media-to-text recognition technologies, including speech-to-text (SR), text-to-speech and handwriting-to-text (Shadiev, Hwang & Huang, 2013; Konur, 2007). The SR is one of the technological tools that synchronously transcribes speech input into texts, and enables users to view them on a whiteboard or computer screen (Hwang, Shadiev, Kuo & Chen, 2012; Wald, 2010). Wald (2008) concluded that SR verbatim transcriptions help to develop better comprehension skills, particularly for those who struggle taking notes at the same time as thinking, listening, and watching, and also for those who missed the class or lecture. For instance, for students with physical health problems, mental issues, health issues such as hearing or seeing, the use of SR would be beneficial (Wald, 2008). One of the advantages of the SR has been stated in a research study: "It's like going back in time to the class and doing it all over again… and really listening and understanding the notes and everything… and learning all over again for the second time" (Leitch & MacMillan, 2003, cited in Wald, 2008).

An important contribution of SR for people with disabilities is to create greater independence, due to the fact that most of them depend on other people to do necessary things such as writing, reading,

gathering information from Internet and many others (Alapetite, Andersen & Hertzum, 2009). The SR enables them to control and navigate computers actively with their own voices, and eventually improve their comprehensive skills, writing, reading and listening skills at any age. Moreover, when typing is painful and difficult for people with physical disabilities such as cerebral palsy, apraxia, visual impairments, spinal cord injuries, repetitive stress injuries, the SR would allow them to govern computers less physically by cognitively engaging them in their jobs and lives (Wald, 2008; Shadiev, 2012). By extension, the SR can simplify the mechanical aspects of typing and handwriting, and consequently remove the challenges of typing and expressing fear of thoughts. Nisbet and Wilson (2002) conducted a project called The Speech Recognition in Schools Project where SR was analysed in terms of how to provide extra support for the students with reading, writing and spelling difficulties. The SR was used to convert the speech of the students' into written text for those with writing problems. 23 schools with 32 students in total participated. Individual SR usage sessions were employed with the students by providing simultaneous texts of their own speech. Pre- and post-tests were employed. The results showed that the SR was effective in providing practical writing method for students with writing problems. They reported more independence in writing and improved writing speed. For those with reading problems, SR texts were found to be considerably better, compared to the students' notes which supported the level of reading of the students. In terms of spelling outcomes, recording the students' voices and giving instant feedback were seen as useful in developing better spelling skills for the students.

The Use of SR in Students with DHI

The advantages of using SR programmes for people with DHI were investigated by some researchers. Studies in general concluded that the SR technology has the potential to support the different communication and educational needs of the people with DHI (Kheir & Way, 2006; Wald, 2008, 2010; Leitch, 2008; Wald & Bain, 2008; Zhili, Wanjie & Cheng, 2010; Shadiev, 2013).

The literature suggests that the comprehension skills of students with DHI can be enhanced by the use of SR. According to the study by Leitch 2008, IBM ViaVoice software was used to assess whether the SR could assist learning skills of the students with DHI in three Canadian high schools. The instructors applied SR for 5 months during lectures, and transcriptions of the lectures were simultaneously displayed on a whiteboard for the students. 44 students with DHI (25 female and 19 male) in grades 9 through 12, and 6 special education teachers (3 female and 3 male) participated in this study. A combination of qualitative and quantitative methods was used to assess the impact of SR on the students' performances and the accuracy of the teachers' spoken lectures. Overall findings suggested that SR texts helped the students to understand the lecture content better and improve their learning achievements. The students with DHI reported that it was easier to understand subjects when both visual and auditory stimuli were used simultaneously.

Another study by Elliot et al. (2002) investigated the impact of SR on the comprehension skills of student with DHI. USA high school and college students were provided with real time transcripts of the covered lecture topics on their own laptops. The SR program called C-Print was employed for ten weeks with high school students and for sixteen weeks for the college students. The total number of 26 students with DHI and 10 teachers who employed the SR were interviewed. Different findings emerged as high school students with DHI used the SR notes for filling the understanding gaps about the covered topics while collage students with DHI mostly used them to prepare themselves for the tests and to write research papers.

SR use was seen as helpful in supporting comprehension skills, depending on the learning behaviours and preferences of the students with DHI. For instance, for high school students with DHI, SR notes were seen as important to enable them to fully understand the classroom subjects, since they often missed a number of auditory inputs depending on their language skills (Elliot et al., 2001). Considering college students with DHI, they used SR notes in more complex and active ways, compared to the high school students. They used SR notes to compare them to their reading and note-taking. As one student reported "*The first time I view it, I just skim it and see what is there. The second time I review it I look for any- thing to underline, important stuff.... Sometimes when I'm not confident I look through it for a third time to study. Usually when I underline stuff I re- member and it just sort of stays with me.... Some- times I have a friend of mine in the same class ask me what did the teacher talk about or was there an explanation for this? Sometimes I will not remember and I will sort of find the copy of the notes and I'll say, "Oh, the teacher said this."... That's pretty much the way that I use those notes"* (Elliot et al., 2002, pg. 32).

Wald and Bain (2008) and Wald (2010) employed IBM ViaVoice speech to text software in order to understand how the SR application could contribute to improving the learning skills of the students with DHI. This study is one of the only pieces of research that investigated the effectiveness of SR on students with DHI in the literature. This is the most comprehensive study in this respect, since little research has been conducted in this area (Shadiev, 2013). A multimedia program called Synote was used, which provided multimedia recordings synchronized with transcripts, images, slides, bookmarks and "information about sounds or tone of voice or emotions or synchronised links to videos of sign language translations" (Wald, 2010, pg. 181). To help the students with DHI and other disabilities to follow the speech of the lecturers, Synote showed the spoken words as highlighted while the recordings were played. The researchers recorded around 500 lectures by using the SR and Synote system over 3 years period from 2007 to 2010 on 5 undergraduate and postgraduate modules in the University of Southampton's School of Electronics and Computer Science (ECS). All of them were synchronised with transcripts, enabling to students to search titles, notes, and text content. The number of participants was 101, as university students portrayed varieties. For example, 55 of them were native English speakers (students without any disabilities), 3 students with DHI, 4 with learning disabilities, 3 with other disabilities and 34 students who were non native speakers of English. The participants completed a

questionnaire, and individual interviews were conducted with them. The results showed that the SR application was useful to support the learning skills of the students with DHI, supportive in note taking, and enabled them to follow speeches of the lecturers' while having transcribed texts simultaneously on the board, and obtaining better recorded sound files with a high quality microphone, rather than depending on their own sound recording devices. The most highlighted benefit of SR was in terms of note-taking support, as the students stated that they had considerably difficulty in note taking while listening to the lecturers and trying to understand the subjects. Another important result was the support of SR sounds recordings and transcribed texts. As one interviewer stated, "*I think Synote is a very good way to listen to lectures. If for example we miss the lecture we can actually listen to it in our own time or if we didn't really understand the lecture we can go back to it and listen to it carefully. I also like the highlighted part whenever the lecturer speaks on the text so we can't actually get lost within long texts."* (Wald, 2010, pg. 183). Other results suggested that the STR helped the students to clarify the lecture contents, compensate missed points and eventually improve their comprehension skills. Also, having lecture transcriptions and sound files enabled them to study these documents in location and time free circumstances which was seen as an important contribution for the students with DHI (Wald, 2010, pg. 184).

Very little research has been found in the literature about the SR applications in secondary schools for students with DHI. Zhili, Wanjie and Cheng (2010) studied the effects of employing SR technology in Chinese for students with DHI in secondary schools, and analysed the factors that influenced SR application. This is the only study I was able to find. The participants were six special education teachers and 62 students with DHI from three different schools for the deaf and hard of hearing in Beijing. The age of the students ranged from 11 to 14 in secondary level. The main communication type that most of the participated students held was that of sign language and lip reading. Semi-structured interviews and questionnaires were conducted with teachers and students. ViaScribe SR software in Chinese was implemented in 6 classrooms. The teachers' voices were transcribed simultaneously on a whiteboard simultaneously during the lectures. The transcribed texts were edited to correct the mistranscribed words after the lectures and given to the students as lecture notes. The results demonstrated that 81 percent of the students reflected that the lecture notes generated by the SR were beneficial to study, which supported them in recalling what had been covered compensated for any missed information. 64 percent of the students suggested that the SR live transcriptions provided useful visual and auditory stimulation and information to support their learning, compensating for "the lost information by sign language" (Zhili, Wanjie & Cheng, 2010, pg. 4). Another important point was the number of modalities by which information was presented. The students felt distracted, since there were sign language, lip reading, speeches of the teachers and SR real time texts appeared on white board. 55 percent of them stated that their attention was distracted in such circumstances. In terms of accuracy issues of SR, 36 percent of the students reported that the wrong transcriptions negatively influenced their comprehension skills during the lectures. The teachers' responses demonstrated that all of them

expressed concerns about the low recognition rate of SR. When there were some serious recognition errors, the class order was negatively affected along with creating commotion among the teachers and students. Improving the speech model that better recognised the speakers' voices later was found to be time consuming. 100 percent of the teachers reported this as a problem. Another point made by 83 percent of the teachers was that their enthusiasm decreased when the recognition errors and computer problems occurred. Some of the issues were unsaved voice files and texts, and unexpected drops in recognition rate which were mostly caused by the quality level of the used computer processors. 50 percent of the teachers pointed out that since their voices were recorded and printed out as a classroom note, they needed to pay more attention to what they spoke. They felt uncomfortable, and demonstrated unwillingness to expand the contents of the lectures, instead they only focused on the lecture themes to clearly explain them in most basic and short ways. It directly affected their normal teaching styles. Finally, 33 percent of the teachers acknowledged that the SR application was not suitable for some teaching contents, such as in mathematics where the vocabularies are specific and includes mostly numbers. Also, when the teachers and students with DHI needed to physically perform teaching and learning tasks such as moving in the class, playing games etc., the SR was not highly applicable.

Issues with SR Applications

The literature identifies issues in SR use. These issues can be categorized under two main themes. The first one is about users considering the SR application as not a useful tool to support their learning (Hwang et al., 2012; Kuo et al., 2012; Shadiev et al., 2013). According to these studies, students expressed some negative perceptions. Hwang et al. (2012) argued that those with high level of success in their degrees were not interested in watching the screen to read the transcriptions of SR. In addition, some respondents with negative perceptions illustrated that watching real time transcriptions were not their type of learning. Instead, they preferred to take their own lecture notes (Shadiev et al., 2013).

The second issue was the accuracy rate of SR technology. This was considered to be a fundamental issue, with Wald and Bain (2008) arguing that accuracy depended on several factors, including the lecturer's experience, speaking ability, the dictionary of the SR software (problems especially in specific terminologies) used, issues with spontaneous speech which can be riddled when the speaker hesitate or stumble over words (Shadiev, 2012). The studies investigating this issue acknowledged that SR texts could sometimes include many errors which could make texts meaningless or incomprehensible (Aylesworth, 2005; Fichten et al., 2000; Kheir & Way, 2006; Konur, 2007; Alapetite et al., 2009; Wald, 2010). Aylesworth (2005) suggested that formatting options such as dictating question marks, new paragraphs, exclamation mark etc. into the SR software during lectures and correcting errors could simultaneously be challenging for the lecturers. Another issue with low accuracy rate is the microphone sensitivity and positioning of the lecturer. Kheir and Way (2006) found increase in the distance between the speaker and the microphone; microphone being too close to the speaker, the SR

transcribing any sound whether meaningful or not. Similarly, Wang et al. (2010) argued that an unsettled microphone positioning could cause interruptions to the SR transcriptions that could "hinder the students' understanding of oral lectures (Wang et al., 2010, pg. 8).

A number of researchers have suggested that there should be training sessions for the SR users to obtain a better dictation accuracy (Jones, 2005; Way et al., 2008; Wald, 2010; Leitch, 2008; Hwang et al., 2012; Ranchal et al., 2013; Shadiev, Hwang & Huang, 2014; Shadiew et al., 2016). A study by Wald (2010) demonstrated that when users were trained and the dictionary of SR was adopted with unfamiliar domain specific terminologies, the accuracy rate of the SR reached 91 percent from 75 percent. Hwang et al. (2012) indicated that training scripts could be used in connection with the learning material; in doing so, SR technology can record specific terminologies, which can later be recognized during lectures. Moreover, users can add frequently used words or any word in the SR dictionary that can better recognize them. Furthermore, the SR correction tool could be used simultaneously during lectures to correct misrecognized words, which works by voice orders such as deleting the last word or deleting the last sentence (Ranchal et al., 2013). Kuo et al. (2012) suggested that the speakers could increase the level of accuracy rate by speaking with moderate volume and speed and with better fluency by avoiding non-lexical utterances (e.g., "uh", "em"). In addition, Shadiev et al. (2016) suggested a set of guidelines as to how to properly use the SR in the classroom. He explained that the speakers should repeat the questions the students ask and then respond, keep sentences shorter, correct mistakes in the transcript simultaneously while using the SR, and make breaks periodically to check on the reliability of SR texts.

Summary

The review of the literature suggests that there are different approaches to define disability and offer solutions accordingly. This is important because interventions provided for people with disabilities by people are mainly shaped by how they consider disability whether as a biological or social phenomenon. It is evident in the literature that ICT provide various advantages for people with SEN and DHI including developments in cognitive skills such as in reading, writing, comprehension, listening. Transferring information through audio-visual ways indicate that ICT could enhance the comprehension skills of learners. In terms of social skills, ICT has the potential to enhance social participation and motivation in students with SEN and DHI.

Considering facilitative and hindering factors, there are several topics which could be facilitative or hindering factors depending on how successfully people make use of them. These are ICT usability, flexibility, affordability, accessibility issues, infrastructure, teacher trainings, the level of confidence and motivation, teachers' and students ICT knowledge, administrative support, teachers' and principals' attitudes towards ICT, pedagogical adjustment and belief, and ICT fit with the curriculum.

The literature also reports on identifying how TSL and ICT respond to teaching TL in special education context for students with DHI and the structure of TL. It is followed by the literature

concerning SR application in education of students with DHI which addresses development of comprehension via providing information in audio-visual ways by SR and supporting note-taking needs of students by generating classroom notes. The literature also reports problems with SR application including transcribing accuracy which is a significant factor in its usage preference by teachers and students.

This study addresses the gap about SR application in special education schools to support pedagogy and provide communication access for students with DHI. There are limited studies and information found in the literature about this issue. Also, there are no studies found in the literature about SR application in Turkish special education schools concerning students with DHI. Therefore, this study sheds a light on this phenomenon.

Another gap in the literature is about providing ICT which utilise communication access for students with DHI in the classroom. There are some useful ICT in this respect, however, SR application have been little researched. Therefore, this study provides knowledge about how SR supports communication skills of students with DHI and teachers in the classroom by generating audio (sound recordings) and visual (transcribed texts) materials.

Supporting note-taking skills of students with DHI via ICT is also another gap identified in the literature. Apart from note takers support, the number of ICT in this respect has been found quite limited. However, SR support has been considered effective and valuable. This study, hence, utilises important knowledge about how note-taking features of students' with DHI in Turkish schools could be supported by SR (Dikte).

CHAPTER THREE: METHODOLOGY AND METHODS

Methodology has been described as a strategy for an action which is based on a choice (Crotty, 1998). Accordingly, methodology "is the theory of how inquiry should proceed. It involves an analysis of the assumptions, principles, and procedures in a particular approach to inquiry" (Schwandt, 2001, pg. 193). In similar vein, Gough (2002) sees methodology as the logical fundamental for conducting research. Methodology is concerned with "why, what, from where, when and how data is collected and analysed" (Scotland, 2012, pg. 9). It is further stated in Guba and Lincon (1994, pg. 108) that methodology asks questions about "how can the inquirer goes about finding out whatever they believe can be known?".

Methodology also demonstrates the structure of a research project by considering the fundamentals, principles and assumptions. For instance, Lather (1991) addresses the fact that research studies in the interpretivist paradigm mostly employ participant observation as part of methodology, since this is the mentality of the paradigm to learn from the participants' experiences regarding their cases. Creswell (2009) elaborates on interpretive methodology by indicating that it concentrates on understanding the subject from individuals' perspectives by studying the interaction between them. Researchers should thus rely on the participants as far as possible, and establish interactions with them. In this methodology, researchers (Scotland, 2012, pg. 12; Cohen et al., 2007) usually employ grounded (inductive) theory by obtaining data from the participants without preceding it.

The primary purpose of this study was to examine how ICT is used in special education schools to support pedagogy and to promote curricular and communication access for students with hearing impairment. More specifically, this study aimed to identify the perspectives of the teachers, principals and students on the nature and usefulness of ICT in a Turkish special educational school with a particular emphasis on examining a Turkish speech recognition program called Dikte. Secondly, the study investigates new ways of teaching and learning by building an enhanced communication environment by using Dikte, which allowed participants to experience new learning opportunities. A mixed method data collection was used to gather data, and grounded theory principles were employed to analyse the collected data.

The following sections present the research design, data collection procedures and time frame, school setting, participants, research questions, analytical plan and data analysis, commenting on the validity and reliability of the study and on ethical considerations.

Research Design

Due to the exploratory nature of this study, the selected research methodology was based on a mixed method approach by collecting data from questionnaires, interviews and observations, which were deemed most appropriate to provide breadth and depth of information. A mixed methods approach was selected for use because it was deemed to provide a methodological unification of qualitative and quantitative data, and usually leads to better outcomes by triangulating them compared to a single-

method research (Karsenti, 2009). Moreover, according to Tashakkori and Teddlie (1998, pg. 7), by combining qualitative and quantitative methods, the researcher can "utilize their respective strengths and escape their respective weaknesses". A clear definition of mixed methods research is provided by Creswell as "a mixed methods study involves the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research" (Creswell, 2003, pg. 212).

The research design supported the researcher in connecting the research questions to the data by following a strategic plan (Denzin & Lincoln, 1994). The research design of a project generally deals with four main components, these being what strategy to follow, within what framework, from whom (sampling) and how the data are collected and analysed (Punch, 2005). In this study, a combination of qualitative and quantitative approaches was used as a strategy to follow as described multi method (Brewer & Hunter, 1989) or mixed method (Creswell, 1994). One of the reasons for using mixed method for this study was to strengthen the validity of the findings by confirming and contrasting sources of data for the purposes of comparing the results of qualitative and quantitative investigations of the same phenomenon (Hammond & Wellington, 2012). Triangulation was deemed to be important in this study to address the complexity of data better than qualitative or quantitative research in isolation, as it enabled the researcher to simultaneously obtain data from a combination of exploratory and confirmatory questions. It also provided a more complete picture and valid inferences of the researched subjects by combining the different outcomes of qualitative and quantitative methods. Another reason for triangulation was to take advantage of the strengths of both methods, which played important roles in data collection and analyses. Qualitative research findings provided background information about the subjects of investigation, which would not be possible to acquire with a quantitative method alone. Moreover, qualitative research methods enabled the researcher to obtain the perspectives of the studied population.

Research Setting

The special education school in this study is named in Turkish "Konevi Isitme Engelliler Ortaokulu" and in English "Konevi School for Hearing Impaired" in the city of Konya in Turkey. This is a government-run school that provides a nursery, primary and secondary school education for students with DHI. Konya is mainly regarded as a traditional and typical Turkish city. The economic status of this city is reported to be average compared to the whole country (TUIK, 2015).

Most of parents of children in the school were working class with a relatively low educational background and income as stated in the school's parent income and educational background reports. These families culturally represent a typical Turkish family structure that is mostly authoritarian, respects authority with a strong interdependence among family members. In a typical Turkish family, the family

unit is considered as the main source of psychological, social and financial support (Dogan, 2010). Intensive interactions among family members occur throughout life, during national celebrations, in weddings, funerals etc. and home visits which are very common as well. For instance, aging adults largely consider the family as the main source of welfare and seek to maintain close physical proximity to family members. Turkish parents, in return, endorse a cultural view of having more control over their children, which in return encourages interdependency among family members (Coskun & Akkas, 2009; Dogan, 2010).

The social stigma attached to disability in wider society in Turkey illustrates that having a child with a disability is still considered something to be ashamed of by parents. Even though there have been important changes regarding social stigma over the last decade due to social, educational changes, this is still experienced as an issue in the country (Meral, 2013). This further discourages the inclusion of people with disabilities in society, where Turkish society's record has been reported as being very poor (Aktas, 2010). This cultural perception has left a number of Turkish disabled people seemingly invisible, to "live hidden from view, out of sights of neighbours and the community and mostly stay at home or in care centres' (Sussman, 2011, pg. 23).

Parental depression is a major problem that can be difficult to tackle when having a child with disability. Schools and Government support in this respect is provided for parents, whether psychological, economic, rehabilitative or social. The Ministry of Family and Social Policies of Turkey and the Ministry of National Education of Turkey are responsible for organizing this support. For instance, mothers or caretakers of disabled people are provided with a financial grant, especially those who are low-income mothers, and significant financial support in health care is provided, as well as tax-free economical support and much more. However, meeting the requirements of parents has been insufficient, even though some interventions take place to develop better parental support in the country. Family education programmes in Turkey have proved effective; however, the prevalence and effectiveness of such intervention is still limited, and even unavailable in some parts of Turkey (Meral & Cavkaytar, 2013). Moreover, there are no other initiatives or outside support to improve school-parent communication (Girgin, 2012). However, school-parent communication channels are open, in the sense that teachers are active in developing and maintaining close relationships with parents, and vice-versa.

Sampling

Sampling has been described as the process of drawing a representative number of individuals from the entire population of people being studied (Cohen, Manion & Morrison, 2008). When one considers the high number of students with DHI, their teachers and the principals who govern the schools for this population, the number reaches millions worldwide (WHO, 2015) and specifically, taking account of Turkish contexts, it is in the thousands (TUIK, 2015). To identify a sample group of the students, teachers and principals, a convenience sample was used in this study. Considering the purpose

of practical examination of a speech recognition program in this study, choosing one school for the hearing impaired and implement the programme was an effective way of investigating ICT use and implementation. However, implementation of SR required physical effort to set up technological equipment each time to use, time commitment where specific times had to be arranged to implement Dikte in classrooms and availability of school infrastructures including computer, projector or whiteboard.

The researcher employed specific criteria to choose students with DHI for interviewing. These criteria was based on the fact that students with moderate hearing loss were able to hear to some degree, process audio-visual teaching components and express themselves orally compared to other students with severe or profound hearing loss who were less likely to benefit from audio-visual teachings (Antia et al., 2009). Another criterion is that benefiting from Dikte requires the skills of understanding oral language up to a certain level. The chosen population of students was eligible because they understood oral language. It was quite important to take advantage of SR teachings in audio formats. Another specific criterion for the students was not having additional disabilities such as dyslexia, blindness, learning disabilities etc. With this in mind, the total number of potential students for interviews who were identified by the teachers and the researcher was 21. Of this number, 10 students consented to participate in interviews. In terms of gender, half the students were male, while the other half were females, however, gender was not a selection criterion in this study.

In forming a sample regarding the number of teachers for Dikte implementation, only 16 of the 20 teachers were available to implement Dikte in their classrooms. Because, 2 sports teachers did not have their own classrooms and for other 2 teachers, their schedules did not fit with the time frame of Dikte's implementation. However, all teachers consented to complete the questionnaire.

This study also involved interviewing 3 principals (1 main principal and 2 vice principals) to investigate their perspectives about the use of Dikte for teaching and learning. Since the total number is just 3, there were no selection criteria, and all of them agreed to participate in this study.

Participants

Sixteen interviews were conducted with special education teachers of students with DHI in April 2014 in the city of Konya, Turkey after 10 weeks of Dikte implementation. Also, 20 responses were gathered from questionnaire. The age range of the teachers was between 28 and 60, with 8 of them being female and 8 male in the interviews, and 10 females and 10 males in the questionnaire. The years of teaching experiences of the teachers in this school ranged from 1 to 30 years. The professions of the teachers demonstrated 9 different subjects, these being Turkish Language, Technology Design, Mathematics, Social Sciences, Science, Arts, Music, Sports and Religious Studies teaching in secondary schools. In considering teaching qualifications, all of the respondents held a university degree. Only one teacher (5%) had a master's degree in Special Education.

Teachers	Gender	Age	Grade and Subject of teaching	Years of experience in this school	ICT training taken or not	Sign language level Does not know Beginner Intermediate Advanced
Teacher 1	Male	29	7-8. Turkish Language	3	Yes	Beginner
Teacher 2	Female	30	6. Turkish Language	3	Yes	Beginner
Teacher 3	Male	37	6-7-8. Social Studies	3	Yes	Intermediate
Teacher 4	Female	38	5-6-7. Technology Design	7	Yes	Intermediate
Teacher 5	Female	37	5-6-7. Science	2	Yes	Does not know
Teacher 6	Male	60	7-8. Science	30	Yes	Intermediate
Teacher 7	Female	37	6-7. Mathematics	8	Yes	Intermediate
Teacher 8	Female	32	8. Turkish Language	3	Yes	Beginner
Teacher 9	Female	42	6-7-8. Science	3	Yes	Intermediate
Teacher 10	Male	35	6-7-8. Social Studies	1	Yes	Does not know
Teacher 11	Female	36	5-6-7-8. Religious Studies	2	Yes	Beginner
Teacher 12	Male	36	7-8. Mathematics	3	Yes	Beginner
Teacher 13	Female	33	5-6-8. Mathematics	3	Yes	Beginner
Teacher 14	Male	50	8. Turkish Language	3	Yes	Intermediate

Teacher 15	Male	60	7-8. Science	2	Yes	Beginner
Teacher 16	Male	56	7-8. Technology Design	25	Yes	Advanced
Teacher 17	Male	40	6-7-8. Sport	15	Yes	Intermediate
Teacher 18	Female	34	5-6-7-8. Art	4	Yes	Beginner
Teacher 19	Male	39	5-6-7-8. Art	12	Yes	Intermediate
Teacher 20	Female	36	5-6-7-8. Music	3	Yes	Does not know

Table 2. The profiles of teachers participated in questionnaire and interviews.

Among these teachers, teachers from number 1 to 16 have participated in interviews and Dikte implementation process. The reason was that the rest of the teachers (number 17, 18, 19 and 20) did not have their own classrooms, rather art, music and sport settings in the school. They did not have smart board1 or computer-projector devices to be able to employ Dikte and did not take part in interviewing process. However, they participated in the questionnaire.

Ten interviews with students with DHI were conducted, including students from sixth to eight grades (12-15 years old) at secondary school level. Oral language was initially planned to be used in the interviews with the students; however, they requested TSL to be used during the interviews to facilitate comprehension. The reason for this was that some students felt uncomfortable when speaking due to their low level of speaking skills, while others reported that they were better at using sign language to express their ideas. Therefore, the interviews were translated by an official sign language translator, who is a special education teacher in this school.

All students with DHI who took part in this study experienced moderate (41 to 55 dB) and moderately severe (56 to 70 dB) hearing loss. The onset of deafness was categorized according to prelingual or postlingual stages: all of the students in this study had been diagnosed with hearing loss before they began to speak (prelingual stage). Regarding the type of deafness, whether sensorineural or conductive or mixed types, almost all of the students (96%) had sensorineural deafness, with 4% having the mixed type. Sensorineural hearing loss is typically caused by damage to the nerves of the cochlea in the inner ear, or in the central sound processing centres of the brain. All of these students have had congenital deafness. According to the students' health reports, 96% of the students had sensorineural deafness caused by congenital factors, and are prelingually deaf or hearing impaired. In fact, the statistics of the deafness types of the students show that there is a heterogeneous distribution of 96 % sensorineural and 4% mixed types in this school, since the majority of them had sensorineural deafness. Therefore, the fact that the students had the same type of hearing impairment was coincidental.

Name	Sex	Age	Deafness Severity	Age of Deafness Onset	Deafness Type	Deafness Cause
S.1	Male	12	Partial	Prelingual	Sensorineural	Congenital
S.2	Male	13	Partial	Prelingual	Sensorineural	Congenital
S.3	Male	13	Profound	Prelingual	Sensorineural	Congenital
S.4	Male	15	Partial	Prelingual	Mixed	Congenital
S.5	Male	14	Partial	Prelingual	Sensorineural	Congenital
S.6	Female	12	Partial	Prelingual	Mixed	Congenital
S.7	Female	13	Partial	Prelingual	Sensorineural	Congenital
S.8	Female	14	Partial	Prelingual	Sensorineural	Congenital
S.9	Female	14	Partial	Prelingual	Sensorineural	Congenital
S.10	Female	14	Partial	Prelingual	Mixed	Congenital

Table 3. Profiles of interviewed students with DHI

Name: S = Student

The last interviewed group was three senior school managers. One of them was the principal of the school, and the other two were vice-principals. All of them had been teachers of different disciplines before working in this position. They had between 8 to 20 years of experiences in leadership positions, and their ages ranged from 38 to 50 years old. They were also responsible to teach 4 hours per week in the school about their teaching professions.

School Managers	Gender	Age	Grade and Subject of teaching	Years of experience in leadership	Years of experience in this school	Sign language level Does not know Beginner Intermediate Advanced
Principal (Principal A)	Male	50	7-8. Religious Studies	20	6	Intermediate
Vice-Principal	Male	38	6-7-8. Social Studies	8	2	Beginner

(Principal B)						
Vice-Principal (Principal C)	Male	39	6-7-8. Mathematics	10	1	Beginner

Table 4. The profiles of interviewed school principals

Analytical Tool: Grounded Theory

This study adopted a grounded approach as an analytical tool, in that "the job of classifying and interpreting data begins with the data, and is not a handed-down conceptual framework, and it is theoretical in that it seeks to clarify the relationships between the categories which have been generated to describe the data" (Hammond & Wellington, 2013, pg. 82). Strauss and Corbin's model (1990) was employed to build a set of categories. However, the aim was not to adhere to all the assumptions of grounded theory, but rather because it "owes a debt to grounded theory" (Hammond & Wellington, 2013, pg. 86). In this manner, the purpose of analysing the data was to understand teachers', principals' and students' reports of their experiences of teaching and learning in an ICT enhanced environment by implementing speech recognition software.

According to Cartwright and Hammond (2007), grounded theory may guide the researcher to describe a model demonstrating the causal conditions, contextual conditions and intervening conditions that empower a phenomenon and the consequences of that phenomenon. It was also defined by Charmaz (2009) as follows: "it is rooted in pragmatism and relativist epistemology, assumes that neither data nor theories are discovered, but are constructed by the researchers as a result of his or her interactions with the field and its participants" (Charmaz, 2009). In this approach, the data were co-constructed in collaboration with the participants and influenced by the researcher's positions, values, interactions, perspectives and geographical locations (Charmaz, 2009). According to Thornberg (2012, pg. 249) this is the position between the realist and postmodernist views, and explains that social realities "are mutually constructed through interaction and are therefore subject to redefinition, and are somewhat indeterminate." Finally, Charmaz (2008, pg. 402) indicates that a constructivist grounded theory "advocates recognizing prior knowledge and theoretical preconceptions and subjecting them to rigorous scrutiny."

This study has used grounded theory principles as follows: first, this it has sought to generate theory from the data in an inductive fashion, avoiding a dependency on 'particular disciplinary perspectives' (Punch, 2005, pg. 157). This is considered to be an advantage of grounded theory, i.e. it allows the researcher to approach the research open-mindedly, with the aim of generating a theory at the end. The reason for new theory generation is that existing theories have not kept pace with this fast moving field of research. Considering the use of SR for students with DHI, there is no satisfactory theory that exists to properly theorise this phenomenon. In the case of implementing SR in Turkish

schools for DHI, no studies found which has been conducted to investigate SR effectiveness. Secondly, since there is flexibility about the research strategy in terms of systematically coordinating mixed methods appropriately aligned with each other, the analysis of the data offered detailed and combined information. The researcher constructed the data in collaboration and interaction with the participants. The data might have been influenced by the social norms and values of the participants, geographical location of the school, demographics of the students and teachers, financial capacities and situation of the school, the academic levels and knowledge of the teachers in terms of ICT use. In this situation, grounded theory was quite useful to enable the researcher to conduct detective work where nothing was disregarded, but everything was assessed and checked to utilize better data.

Based on these explanations, recognizing prior studies, theories and preconceptions provided important knowledge for the use of ICT for students with DHI. In addition, constructing knowledge in coordination with the participants by exploring their experiences generated crucial information. For these reasons, it was resolved to use a constructivist grounded theory for this study as a primary means of exploring the use of ICT and SR and the pedagogical implications of their application for students with DHI.

Case Study

There has been increasing use of case studies in education research in the last decade (Punch, 2013) and there have emerged a number of variations and definitions of case studies. Beginning with the early definitions of the case study, Goode and Hatt (1952) stated "The case study is not a specific technique; it is a way of organizing social data so as to preserve the unitary character of the social object being studied" (1952, pg. 331). The general idea of the case study examines 'the interplay of all variables' (ICT Special Educational Needs, pg. 47) in a case to provide a comprehensive understanding of the investigated subject. This is achieved in several ways, as Hitchcock and Hughes has stated; case studies are concerned with a rich and vivid description and chronological narrative of events related to the case, focus on understanding the case from the perspectives of those involved, explain particular events regarding the case, and enable the researcher to become involved in the case (Hitchcock & Hughes, 1995, pg. 317, as stated in ICT Special Educational Needs, pg. 48).

One of the specialties of the case studies has been explained as being a phenomenon occurring in a bounded context (Miles & Huberman, 1994). Yin described case studies as having boundaries among the case and the context, which is not always necessarily evident, but needs to be identified as clearly as possible by the researcher. Yin (1984, pg. 23) stated that "the Case Study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used". A case study was chosen since the case was the perspectives of teachers' and students with DHI in terms of ICT and SR use in special education context as real-life example. This case could not be considered

without the context of special education and its classroom settings, because the perspectives of teachers' and students were developed in this setting. The bounded system in this research therefore was examining the special education context in a Turkish school for hearing impaired. However, it would have been impossible for the researcher to obtain a real picture of the perspectives of special education teachers and students' with DHI without taking account of the context within it occurred.

It is important to define clearly what a case is, to determine the units of analysis and to guide the research in a logical and strategic way (Punch, 2005). A case study is a "systematic inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest" (Bromley, 1990, pg. 302). The present study aimed to explore participants' experiences and perceptions within a case study regarding the use of a speech recognition program to support the teaching and learning of students with hearing impairment.

Case studies focus on preserving "the wholeness, unity and integrity of the case" (Punch, 2005, pg. 145). This idea refers to a "holistic approach", which Merriam described as follows: "one selects a case study approach because of an interest in understanding the phenomenon in a holistic manner" (Merriam, 1988, pg. 153). At the same time, it is impossible to cover or study everything in a case; therefore the focus of case studies is specified by the research questions to identify the main context of the cases. In this respect, the research questions of this study translated the general purpose of the research into specific purposes; by beginning with the general purpose of investigation and the use of ICT resources in Turkish special education schools and specifically, to explore an implementation of a speech recognition program for students with DHI.

Another speciality of case study described, "is an inquiry process of understanding a social or human issues in a natural setting" (Creswell, 1994, pg. 1). In this regard, it enabled the researcher to "get under the skin" of an organization or a group to seek out evidence regarding what really happens about the investigated subject from the inside, and the perspectives of those involved (Gillham, 2000, pg. 10). A case study approach fits well with this study, which took place in a Turkish school for students with DHI, where the researcher was able to engage with the students, teachers and principals in their daily educational activities as an insider researcher. The case study was considered most appropriate to deeply explore how the use of ICT and SR were employed in the school by the targeted population. One of the other reasons was that even though the use of ICT is not a new phenomenon for Turkish special education schools for DHI, as the literature review stated, its potential has been unnoticed for decades until very recently, and there is a lack of in-depth research and understanding of its possible outcomes for students with DHI. A case study was deemed to be quite suitable in this respect, so as to explore the benefits of ICT and SR application for students with DHI and teachers.

In terms of the multiple sources of data collection methods, case studies enable the gathering of all data relevant to the case. "The case study method gives a unitary character to the data being studied by interrelating a variety of facts to a single case. It also provides an opportunity for the intensive analysis of

many specific details that are often overlooked with other methods" (Theodorson & Theodorson, 1969, cited in Punch, 2005, pg. 145). According to Stake, case studies enable researchers to conduct qualitative and quantitative methods; however most of the case studies are predominantly qualitative (Stake, 2005). For this study, multiple sources of data collection tools including interviews, questionnaire and observation were used. A case study supports the researcher not to disregard or neglect any evidence, but each piece of evidence was checked and assessed, and was "of some value" for the investigated case (Gillham, 2000, pg.10).

Data Collection

Firstly, a questionnaire was employed to collect information on broad trends regarding the use of ICT in this school, and particularly the challenges of ICT use with students with hearing impairment. The questionnaire was distributed in January 2014 at the school this study took place (see table 5, timeline of key events in data collection). A total of 20 out of 21 responses were returned indicating a 95% response rate. The questionnaire was adapted from the "Information and Communication Technology Usage Survey" developed by Gulbahar and Guven (2008) to collect data from special education teachers. It included 8 sections; the first section had questions on teachers' background. Section two focused on the IT skills of the respondents, including office programmes, computer assisted educational materials, e-mail, chat, blog, forum and electronic encyclopaedia; section three included questions on hardware skills of the respondents ranging from smart board, computer, computer-projector system, Internet, TV/video, camera and audio recordings etc.; section four examined the perceptions of the respondents' about professional development which covered topics such as attending in-service teacher trainings, obtaining extra support from outside and inside resources such as professionals in different schools or organizations and IT services etc.; section five included questions on factors that encourage the use of technology by the respondents, e.g. rewarding the ICT usage skills of the teachers in instructional activities, investment of the schools on infrastructure of ICT materials, developing policies and plans for diffusion of the instructional technologies, carrying out the studies for integration of the technologies into curriculum, and providing support for the projects towards the expansion of instructional materials etc.; section six focused on perceptions about use of ICT with questions mainly beginning with 'I think', 'I do', 'I do not', 'I can' and 'I believe', and continue with such sentences to inquire use of ICT. For instance "I think that I can use instructional technologies in class activities more effectively day by day", and "I believe that tools like e-mail, forums and chat will make communication with my colleagues and students easier"; section seven examined barriers to technology usage such as the inefficiency of teachers' technical knowledge, the difficulties in preparing materials based on technology, inefficiency of institutions technical infrastructure, problems with accessibility to existing hardware and the poor technical and physical infrastructure of the learning environments etc. Finally, the last section of the questionnaire sought to explore the self-perceptions of the teachers. The questions covered a range of different subjects, as follows; ' I can always manage to solve difficult problems if I try hard enough', ' I

am confident that I could deal efficiently with unexpected events', 'When I am confronted with a problem, I can usually find several solutions', 'I can remain calm when facing difficulties because I can rely on my coping abilities' and others.

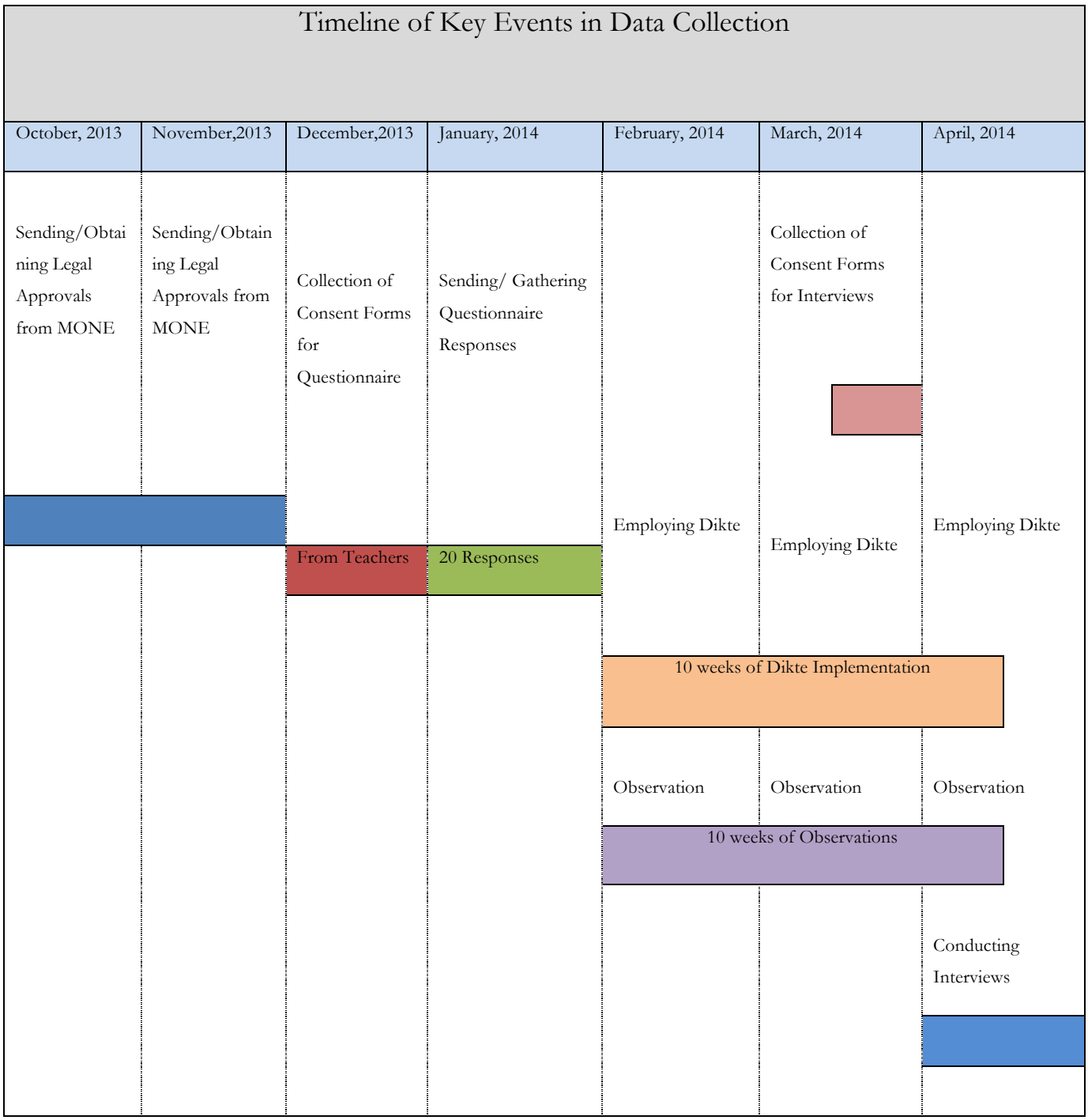

Table 5. Timeline of key events in data collection

The questionnaire was distributed to the teachers and principals as attached in Appendix C. A description of the aims of the study was included in the questionnaire. The participants were informed that they had the right to withdraw from the research at any time without specifying a reason. The questionnaire was designed in a paper format because teachers requested it. After they had expressed a willingness to participate, the questionnaire was distributed to them.

The database was stored in the researcher's computer in a password-protected computer file. All of the responses were then imported into a Microsoft Excel format and the SPSS program for analysis. None of the personal information was included in paper format or printed, however, if any need for data print emerged, the paper copies were protected in the researcher's own filling cabinet. In doing so, there was no accessible information of the respondents and confidentiality was ensured. The period of time that this information will be kept is three years, after which the data will be destroyed.

Secondly, individual one-to-one interviews were conducted with teachers, students and principals. The interview questions were designed by the researcher in order to employ depending on the aim of this study (Appendix B). Consent forms from the students, teachers and principals were obtained at the beginning of the interviews, and they were sound recorded. To ensure the validity of the recorded data, the researcher showed transcripts to the participants for confirmation of the key issues. All of the interviewees except some students with DHI analysed the interview transcripts and agreed that they presented their ideas accurately. The reason why some students with DHI did not read transcripts was that they were not interested in reading them. Since interviews with students with DHI occurred in the presence of Sign Language interpreter (an also interviewed teacher in this study as teacher 16 who has advanced sign language skills), the researcher requested that he examine transcripts. This showed that the transcripts correctly covered key issues. In addition, reliability checks regarding translations of interviews were made by an academician who has special education PhD degree from USA and who is also a native Turkish speaker. The consistency for each theme ranged 75% to 90% between the two raters.

Semi-structured interviews were employed to gather data. Semi-structured interviewing strategy has been described as refining or managing the questions throughout the interview processes to clarify, restate, elaborate the subjects emerged along the way (Mutch, 2005). Semi structured interviews play a crucial role in obtaining depth and insight by regulating the questions relevant to the subject, because the researcher can clarify the questions and utilize probes to receive detailed responses from the interviewees which increase the quality of data collected. It is worth mentioning the interviewer's way of voicing an opinion, the choice of words to probe the respondent, and interpersonal skills may cause biases or errors for the study (Bryman, 2012). One of the main benefits of semi-structured interviews is to ensure that the researcher covers his or her agenda, along with providing opportunities for interviewees to enable them to express their opinions and beliefs related to the topic (Hartas, 2010).

Interviews were planned to provide insights and in-depth information from the interviewees to help the researcher to address particular and general research questions, such as "to what extent, and in what ways, do Turkish special education teachers employ ICT to support learning and teaching for students with hearing impairment?" and "what are the perspectives of special education teachers, principals and students towards the usefulness and effectiveness of ICT/Dikte for students with hearing impairments?." A further main research question "how can the use of ICT provide pedagogical,

curricular, communicational and instructional benefits to schools?" was addressed as a result of interviews. An except of an interview with a student and teacher can be found in Appendix D.

Thirdly, unstructured observation was used to observe and record the behaviour of the participants. It is important during observation to have a clear focus on what and who is to be observed, such as the behaviour of a teacher towards a technological material or students' participation during the classroom activities. The numbers of types of observed behaviours should be kept short, to ensure that the recording system is not overloaded with too many options which may easily confuse the observer.

Unstructured observations were conducted during the Dikte implementation in classrooms. The researcher aimed to observe the behaviours and attitudes of the teachers' towards Dikte, student-teacher collaboration and level of participation and engagement of students' on task behaviours in a more natural open-ended way (compare to structured observations). This also enabled the researcher to validate the teachers' perspectives obtained in the interviews, and be able to comment on what they do in practice. In more details, observations suggested that the students' behaviours have demonstrated differences depending on the types of lessons, subjects and their daily-based moods. Overall, positive behaviours were observed about Dikte, however, some students were bored after 10 or 15 minutes of Dikte implementation, where they seemed tired of reading transcribed texts appearing on the board. The students in general showed very clear indications when they were happy to receive classroom notes by Dikte.

The researcher was able to concentrate on the relationships between teachers and students in the implementation process of Dikte and how the teachers dealt with the issues raised by Dikte. Student-teacher collaboration and engagement of students' on following teachers' speeches during Dikte implementation showed varying data. The students who were seen as more successful than others in the class seemed more carefully following the transcribed texts on the board and asking questions when needed. However, there were many occasions where the students requested the teachers to slow down, stop and allow them to read the transcribed texts. Also, there were some students who requested the teachers to sign some of the words and sentences in Turkish Sign Language (TSL) to better understand the subjects. Some of the teachers seemed having difficulties in engaging with each students since some of the students requested using TSL while others preferred oral language.

Unstructured classroom observation generated important information as the streams of actions naturally unfolded regarding whether the technology made effective use of time for teachers, the willingness or reluctance of the teachers' to use ICT and Dikte particularly in the classroom. Observing the effects of the technology on time management skills of the teachers, the data showed that especially those who were good at technology use demonstrated better behaviours and made effective use of technology for class. However, the teachers had some complaints about the complexity of ICT use especially when the instructions were not clear enough. Some of the teachers were sometimes unsure if

they were doing the right things in using Dikte, and, for example, looked at the board to check if everything was working properly. When transcribing mistakes emerged, some teachers became uncomfortable or uneasy, criticising their own speaking skills or the transcribing accuracy of Dikte software.

Furthermore, classroom observations enabled the researcher to identify how using ICT and Dikte may or may not change the traditional way of teaching. Some teachers demonstrated difficulties in adopting Dikte use where they had to change their traditional teaching method. Using Dikte microphone and connecting to the computer made some teachers uncomfortable about following some specific teaching strategies because of Dikte implementation. For instance, being closer to the computer, not moving far from it, speaking to the computer to control it such as stopping it when there is a question, saying specific words to put punctuations on the text, using a clear pronunciation with following a voice level that was not loud or silent. Not all teachers easily adapted to this way of teaching but difficulties were observed including feeling strange to be depended on a computer to convey teachings.

Analysis Plan

The analysis of the data plays a crucial role in the process of any social research by breaking the data down into smaller units for the purpose of identifying their characteristics and elements, and specifying the interpretation of data (Bryman, 2004). According to Marshall and Rossman (2006), the process of interpretation or bringing order to a mass of collected data could be ambiguous, time-consuming, messy, and creative, which "does not proceed in a linear fashion; it is not neat" (pg. 207), therefore, it is quite normal for a researcher to "feel like an eccentric and tormented artist" (pg. 207).

The researcher employed a data analysis strategy, as introduced by Marshall and Rossman (2006), following seven steps: organizing the data, immersion in the data, generating categories and themes, coding the data, offering interpretations through analytic memos, searching for alternative understandings, and writing the report or other formats for presenting the study. During data reduction, the collected data were brought into manageable units and the words and behaviours of the participants were interpreted by the researcher.

Organizing the Data

It is important to organize the collected data prior to data analysis. There are several strategies to organize data, such as listing the data on note cards, making field notes, making sure that overwhelming or unmanageable data is identified carefully and cleaned up if necessary, identifying the data relevant to the dates, times, the places and the persons that the data is gathered (Marshall & Rossman, 2006). Also the researcher should revisit the mass of data regularly or periodically to be familiar and knowledgeable enough about his/her data to not miss or misinterpret any data that is relevant.

Another way of organizing the data is to use one of several programmes that are specifically designed to organize and analyse qualitative and quantitative data. The most commonly used software for qualitative data analysis is NVivo, ATLAS.ti, Ethnograph, HyperRESEARCH, QDA Miner, MAXQDA, Qualrus, Xsight, Transana, and Coding Analysis Toolkit. All these programmes generally provide coding, retrieval of information, organization, transcription, annotation, classification and self-instructed (Suter, 2012).

The researcher in this study used observation notes which identified the date, time, place and persons involved. To organize quantitative data, the researcher employed the SPSS software. This functioned in conjunction with the interviews to obtain a deeper understanding of the reasons underlying given responses. When it comes to qualitative data organizing, a program called NVivo was used to analyse and keep track of the messy recorded data from interviews (See figure A below). Furthermore, it served to create conceptual maps or cluster ideas under relevant categories. These programmes helped the researcher to organize, classify, code and transcribe the data.

In organizing the data, a unique identifier was assigned to each person, and all information about an individual was gathered in one specific file. In doing so, each participant's information became easily manageable without appearing in several files. A consistent format was used to enter the data, such as numbers from 1 to 10 for students, pseudo names for teachers in NVivo software (later numbers were used for each teacher in reporting relevant data) and numbers from 1 to 3 for identifying principals (later letters A, B and C were used in reporting relevant data).

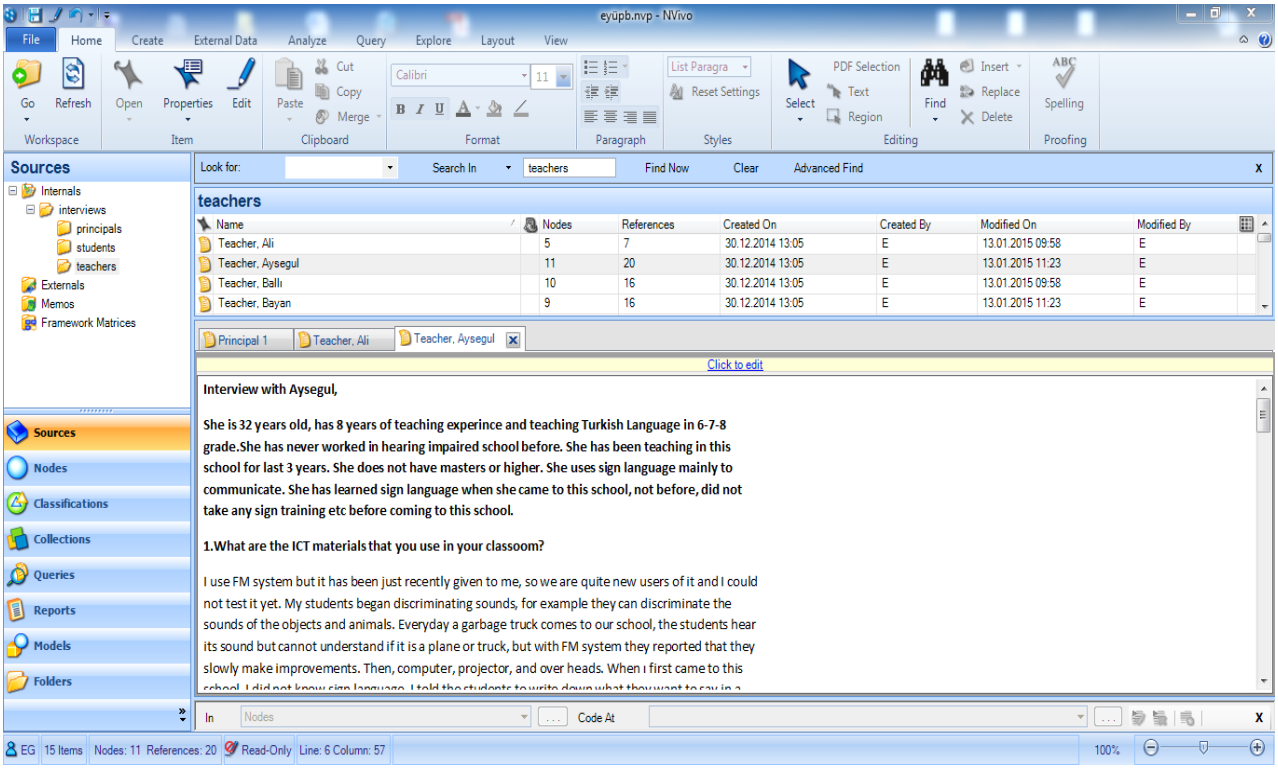

Figure A. Nvivo program used to organise interviews.

Also, created nodes enabled the researcher to organise similar data under appropriate headings. It significantly helped the researcher to organise messy data as the figure B shows below.

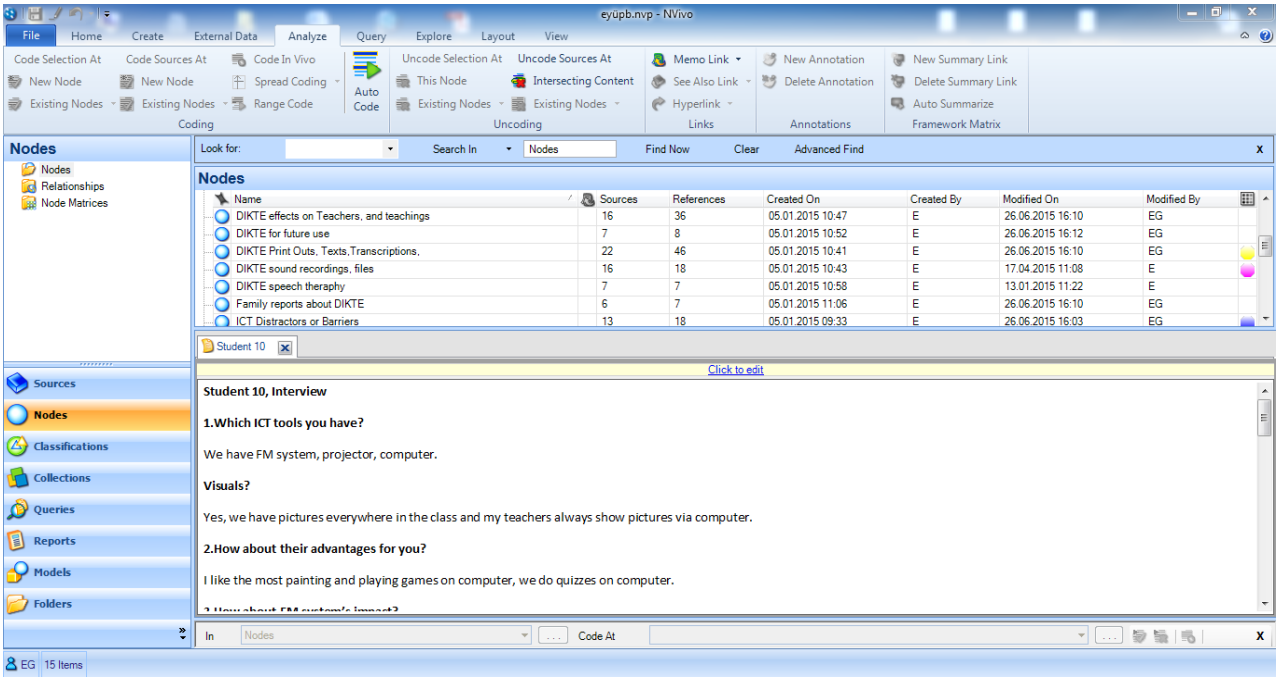

Figure B. Nodes created to organise messy data under appropriate headings.

Considering organising observation notes, they were collected in a notebook for later coding and analysing as figure D shows at page 74.

The data collection process was carefully designed not to negatively affect the flow of daily events in the school in which this study took place. For instance, each teacher decided to host Dikte implementation in his or her class according to their teaching calendar. Some of the teachers used it twice a week, while others used it once as the table 6 below shows an example of schedule of Dikte use.

An Example of Dikte Using Schedule, 7th Grade, Classrom A				
Monday	Tuesday	Wednesday	Thursday	Friday
9.00-9.40 Turkish Language Dikte Implementation with Teacher 1	9.00-9.40 Technology Design	9.00-9.40 Social Studies	9.00-9.40 Religious Studies	9.00-9.40 Turkish Language
10.55-10.35 Social Studies Dikte Implementation with Teacher 3	10.55-10.35 Mathematics Dikte Implementation with Teacher 7	10.55-10.35 Social Studies	10.55-10.35 Religious Studies Dikte Implementation with Teacher 11	10.55-10.35 Turkish Language

10.50-11.30 Social Studies	10.50-11.30 Mathematics	10.50-11.30 Turkish Language	10.50-11.30 Technology Design Dikte Implementation with Teacher 16	10.50-11.30 Mathematics
11.45-12.25 Mathematics	11.45-12.25 Art	11.45-12.25 Turkish Language	11.45-12.25 Technology Design	11.45-12.25 Mathematics
13.30-14.15 Science	13.30-14.15 Music	13.30-14.15 Art	13.30-14.15 Science	13.30-14.15 Science Dikte Implementation with Teacher 9
14.30-15.10 Science	14.30-15.10 Sport	14.30-15.10 Art	14.30-15.10 Science	14.30-15.10 Sport

Table 6. An example of Dikte using schedule.

Immersion in the Data and Generating Themes

This step encouraged the researcher to fully engage with his data by reading and rereading the material several times to become intimate with the data collected. The researcher read and reread the data until becoming knowledgeable enough to make data reduction and interpretation. The use of the graphics and schema ensured better data management as it was recommended by Yin (2003) and enhanced the reliability of data analysis and were especially helpful for case studies. In the process of immersion in the data, a list of themes has been created, which utilized such categories that helped the researcher to better engage with the data. In the case of this study, most of the themes have been derived from the raw data (vivo codes) and some theory-generated codes from the literature review.

Coding the Data

Coding the data comes after generating themes and categories. There are several forms of coding that can be applied, such as abbreviations, numbers, colours and others depending on the creativity of the researcher. This study used Nvivo software to code the data based on created themes. Related data were coded under different themes as the figure C shows below.

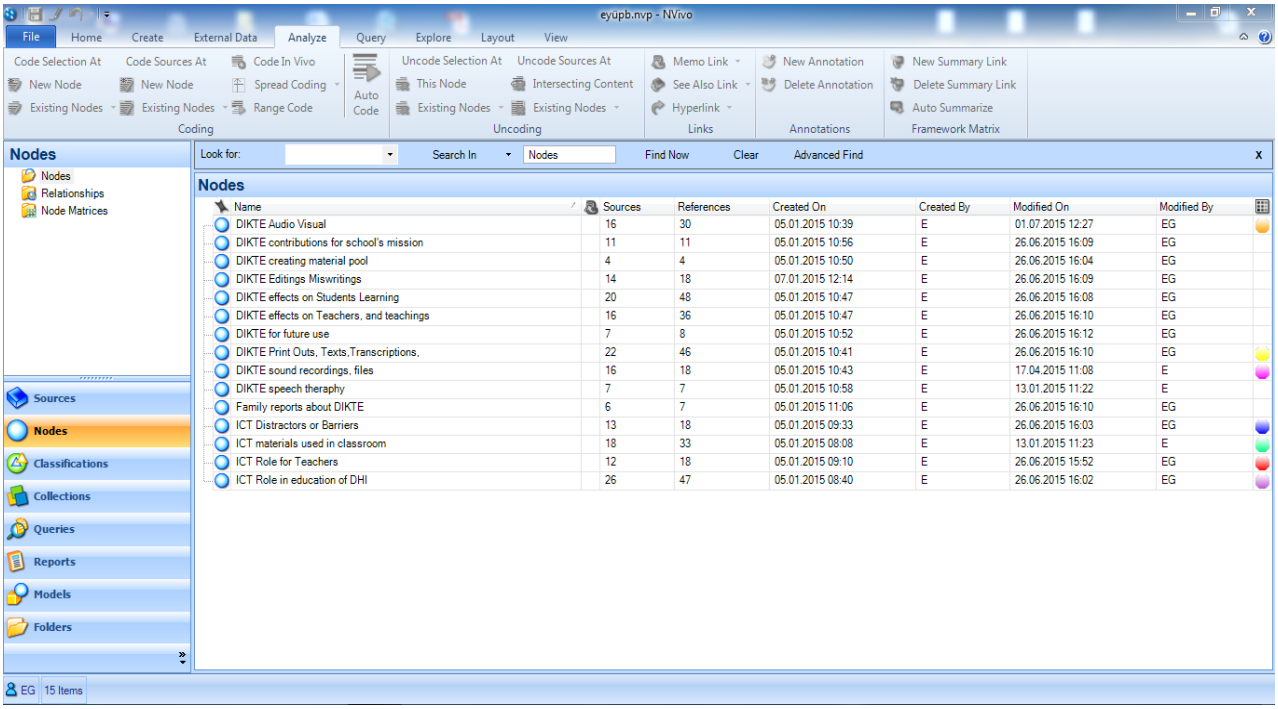

Figure C. Coding the data under different themes.

In this study, the researcher used colours and memos to cluster observation notes in an order such as "the students' behaviours about Dikte" or "the teachers' behaviours about Dikte" etc. Specific colours were used to code the data for instance for students' behaviours and anything related to them were coded in yellow, any information about the teacher's behaviours were coded in purple while the researcher's personnel ideas/interpretations were coded in blue as figure D demonstrates below.

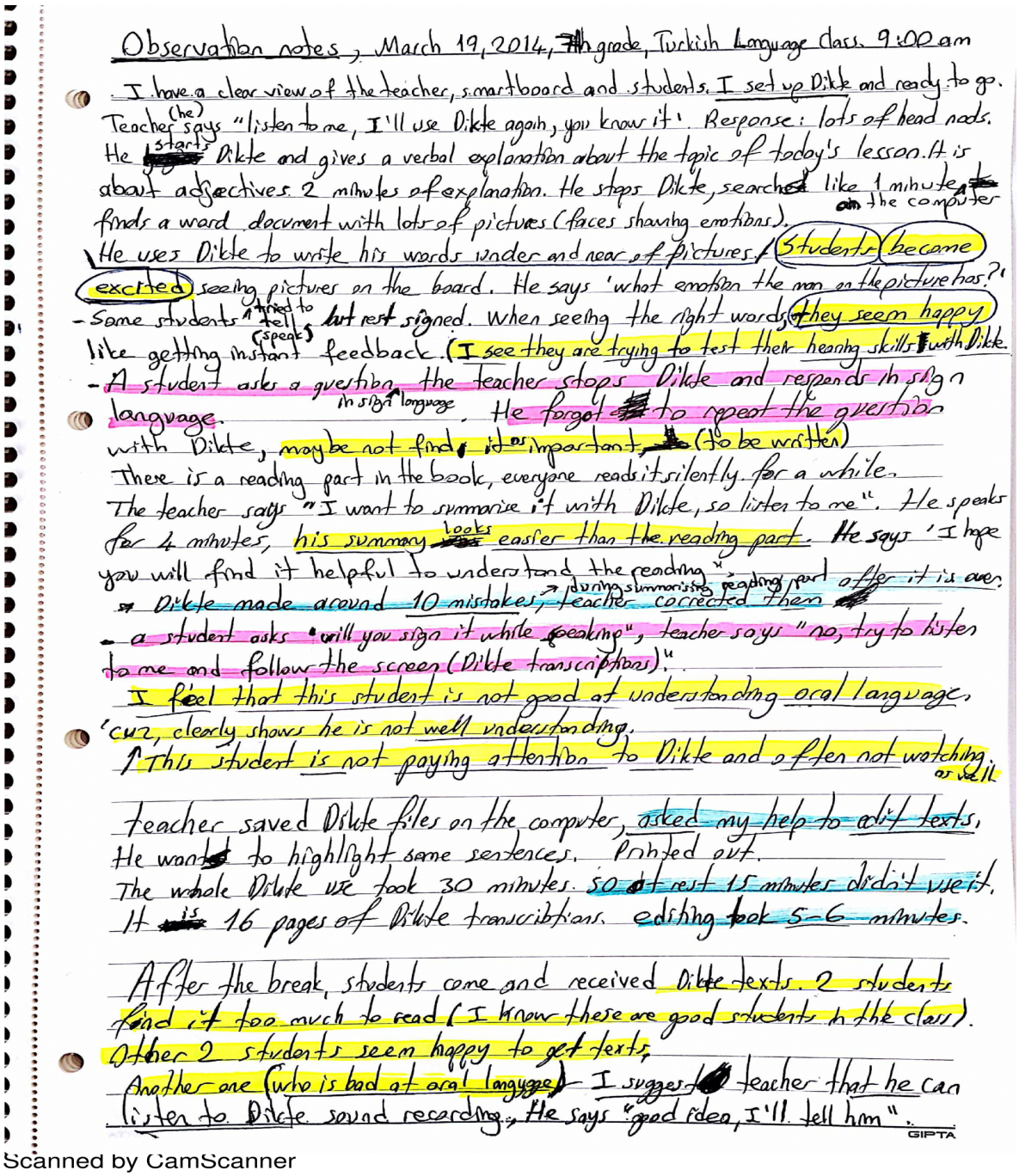

Figure D. An example of observation note and coding

Writing Analytic Memos

Writing analytical memos is important for researchers. As Wolcott (1994) explained those writing analytical and reflective memos, may derive invaluable benefits by using the unusual thoughts or insights to make the analysis more creative (Wolcott, 1994).

The researcher used thematic and observational memos regarding the data as it was accumulating. Some of the memos were of the nature of the following: "I think the interview data is matching with theme 4" or "the set of observation reports in the teacher 5's classroom is a strong evident for the subject of Dikte speech training." Also, writing prompts about codes in the analysing process facilitated

the linkage among the coded data, and by doing so, the researcher was able to draw connections among the coded data and could identify possible gaps in the data. Besides, writing memos provided an outlet for the researcher to think about some more additional data that would be supportive to fully explain some subjects. For instance, the researcher found that the data regarding Dikte note taking support was not good enough to offer interpretations in some of the interview reports. This encouraged the researcher to pay more attention to this subject and collect some additional data during observations and interviews.

The researcher's reflections on particular aspects during data analysing further helped to discuss results more effectively. These reflections were sometimes one paragraph or one page long without paying attention to grammar, spelling or wording. The researcher mostly wrote them to himself rather than to the readers included what was happening in the data, what was the main argument, and what was the researcher seeing etc.

Writing analytical memos were sometimes in a summary format of the patterns found in the raw data. For instance, memo from a class observation stated "those who participated in reading the texts appeared on the board provided by Dikte were mentally (in general) more busy compared to the those who did not. Because, especially those whose reading is poor were more disengaged with the Dikte. This issue was also raised in interviews with teachers. So, I think, if the students are not good at reading the texts appeared on the board, Dikte may not be very attractive for them".

Offering Interpretations

After themes and coding were organized, interpretations were offered, a procedure explained as "attaching significance to what was found, making sense of the findings, offering explanations and drawing conclusions" (Patton, 2002, pg. 480). The researcher sought to interpret the themes, categories, and established linkages among the data components. The grounded approach enabled the researcher to use the categorised data to generate new theories. Considering the principals of grounded theory which is not tied to any pre-existing theory, the researcher was able to generate new theories which were mostly a collection of categories that detail the use of SR and ICT in the education context of students with DHI.

Writing the Report and Representing the Inquiry

The qualitative and quantitative data were analysed together in the analytic process and represented in conjunction with each other. According to Marshall and Rossman (2006, pg. 18), they cannot be separated from each other because of the fact that "many aspects of data analysis process are intertwined with managing the research process". Therefore, the researcher engaged with the data to interpret, shape, form and provide meaning to the raw data in this process and reported accordingly.

Validity of the Study

In order to provide maximum validity, the interview questions were designed to address the research questions in depth. The validity of the data was measured during the interviews where the researcher employed content validity tests. It involved checking and controlling whether the participants provided data in accordance with the research questions. Content validity concentrates on representing ideas and concepts in a measure that should sample all ideas in it (Neuman, 1994 as stated in Punch, 2005). According to Kondracki and Wellman (2002) content validity is influential in directing the interviewees to stay in line with the logic of the research questions. Initial analysis of the validity checks of the interviews suggested that the data considered reliable in terms of measuring the experiences of the teachers, principals and students' about the implementation of Dikte and investigating ICT use.

Another side of validity of this study is based on how well it has described and explained the targeted population and the school in general. The implementation of mixed methods was to support validation in this respect. Triangulation of the data enabled the researcher to combine various perspectives in a complementary manner to demonstrate extensive understanding of the phenomena. This in return surmounts the weakness of a single method (Erzberger & Kelle, 2003).

1.6.5. Role of the Researcher

Firstly, the reason behind conducting this research in this school was to ensure that I could gather as much data as possible, and practically employ Dikte in classrooms. After my initial research into possible schools in Turkey, I found that Konevi School for Hard of Hearing where this study took place was the biggest school in terms of the number of students with moderate to severe hearing loss and number of special education teachers teaching at secondary level.

The extent of my support to the teachers included introducing the Dikte program, helping to operate and manage it during its implementation and editing transcriptions after the classes. I was mostly active in helping them to operate Dikte properly in the first weeks of Dikte implementation, and later, the teachers took the lead. Considering 10 weeks of Dikte implementation process, I only helped them to operate Dikte around the first 2 or 3 weeks. This mostly involved managing Dikte features including start/stop, taking care of punctuations, and sometimes simultaneously correcting mistranscribed words. My main purpose was to demonstrate and teach how to use Dikte properly and to encourage the teachers to use it individually in this respect.

I was involved in this study as both an insider and an outsider, for several reasons. Being an insider/outsider provided both advantages and disadvantages. Beginning with the advantages of being an insider, I was able to blend into the existing setting without disturbing it. By using my previous experience and knowledge in special education schools, I was able to understand the culture, the common language including the "jargon" and history of hearing impaired education in Turkey and relate

to individuals with DHI in terms of being able to read non-verbal cues and understand their corresponding psychological and cognitive precepts. I knew how to appropriately approach students with DHI by using sign language (my intermediate level TSL knowledge), gestures, body language and mimics. This encouraged student to communicate openly with me. However, access to the school community and students' social circles was somewhat challenging, even though I had the privilege of being an academician who was knowledgeable about numerous aspects of hearing impaired education in addition to having a conversational command of Turkish sign language and sharing the same culture and language with them. The disadvantages of being an insider included the risk of compromising objectivity, since familiarity tends to increase the risk of making assumptions based on existing/prior knowledge. Therefore, I sought to remain as objective as possible, by keeping this reflexive issue in mind during data analysis.

I was also involved in this project as an outsider at some levels. I have carefully demonstrated that I was also an outsider and did not relate to the teachers in professional meaning, because I have never worked as a teacher before in special education schools in Turkey or elsewhere. Hence, after guiding the teachers about how to use Dikte properly, by keeping my distance through not being a member of the school, I observed their reactions to Dikte, the students' behaviours, recorded what was actually happening and took notes in the classrooms. I carefully conducted interviews by mostly allowing the teachers and students to express their opinions freely without adding to any potential confusion by probing different questions to obtain information relevant to the research questions. Moreover, I did not demonstrate any prior knowledge or experiences about ICT, hearing impairment or others during interviews, so as not to confuse or lead the interviewers' responses into different directions. However, in certain points, I was careful to use probes to keep the interviewers on track and to ensure that the voices of all participants were equally valued.

I felt slightly at a disadvantage in terms of how teachers perceived me (whether as an outsider or insider) as an academic who is believed to have more knowledge/professionalism than the teachers about ICT in pedagogical and practical aspects. For instance, during and after Dikte application in classroom, the teachers sometimes wished to obtain my perspectives first about the possible outcomes of Dikte application, rather than taking the lead on this issue. I carefully handled this issue by requesting their understanding and perspectives first, and then continuing my communication with them. This issue was challenging for me in the sense that I had to encourage the teachers many times (to believe) that they were the professionals in teaching and I was there to cooperate with them regarding Dikte use.

The fact that I am not a qualified teacher did not seriously affect the process of working together with the teachers. However, in some circumstances, the teachers expected more contribution from me regarding explaining the pedagogical or theoretical aspects of ICT use in classroom. This has sometimes created an environment where I was supposed to comment on possible teaching strategies regarding the

use of ICT. I and the teachers were mostly in agreement about ICT use, however, there were times where some perspectives clashed between me and the teachers such as availability and effective use of educational software in classroom activities. A couple of teachers expressed the fact that they did not wish to use such software, since they did not obtain good results previously. However, my standpoint was the opposite.

The teachers sometimes requested a more active role from me, especially in Dikte implementation. It was understandable that Dikte was a new device and required a new teaching style for the teachers. Hence, to be able to implement it properly, I was requested to participate more actively in its implementation process. This has created a positive interaction with the teachers, as well as challenges. The behaviours of the teachers sometimes led me to feel that they wanted to play a secondary role in Dikte use, rather than having the first autonomy or lead. This challenging issue was resolved by explaining the underpinnings and missions of Dikte use regarding this study's key aspects, in which, the teachers played the main role.

Ethical Considerations

The Ministry of National Education of Turkey Research Department approved this study. All the participants were informed about the specifics of this study including aims, time frame, confidentiality issues and informed consent was received from the participants. The participants were informed on the potential benefits of their participation in the study in terms of accessing Dikte notes in audio and text formats and also testing its applicability for their teaching.

The conduct and findings of this study were not anticipated to cause any ethical concerns or harm to the participants. The researcher aimed to contribute to the field, and develop the ICT practicing areas in educational settings for the benefits of students with DHI. A number of issues regarding data protection, privacy and confidentiality, participants' rights to withdraw were explicitly discussed. Firstly, the students and teachers mailed the questionnaire after all the necessary consent had been collected. Then, interviews with students, teachers and principals were held, based on informed consent. All of the audio taped interviews, questionnaires and other documents stored with restricted access on an external hard drive in password-protected folders. Personal or identifiable information were not recorded or included in any printed documents in order to maintain confidentiality at all times. Also, the language used by the researcher were not biased against any of the participants because of gender, disability etc. It should be acknowledged that concentrating only on students with moderate hearing loss would present a loss of opportunity for other students with different levels of hearing loss, such as students with severe and profound hearing loss. This might be considered to be a limitation of this study, and raise an ethical issue as to whether students with severe and profound hearing loss should have been given a voice as well.

CHAPTER 4: ANALYSIS OF THE RESULTS

Introduction

Having established the research objectives and collected the necessary data (qualitative and quantitative), this chapter presents the results stemming from the data analysis. This process involves abstracting information from raw data and identifying emerging themes for understanding the investigated phenomenon. The analysed data are presented under nine main themes and subthemes which emerged from thematic analysis.

Data handling

Conducted interviews were transcribed immediately to capture important points while they were fresh. The raw data were then summarised to enable coding and identifying themes and patterns. This process was helpful in practical terms for reducing the voluminous data. The coding process mainly consisted of tags and small chunks of data at the beginning. After basic coding, more advanced coding was conducted where the data were categorised based on the emerging patterns. Table 7 below demonstrates the framework used for analysing the coded themes, including data collection tools and participants. SPSS 12 was used to analyse the quantitative results, while qualitative analysis was conducted in NVivo software.

Main Theme	Subthemes	Method of data collection and participants
Theme 1: **Presentation of ICT materials**	• Use of ICT materials for audio logical support • Use of ICT materials for visual support • Facilitating hearing • Technical effectiveness of FM system	**Interviews:** Teachers, students with DHI**,** school principals **Questionnaire:** Teachers **Observations:** Teachers and students with DHI in classrooms

Main Theme	Subthemes	Method of data collection and participants
Theme 2: **The role of ICT in developing educational capabilities and the social participation and motivation of students with DHI**	• Improving academic skills of students with DHI • Promoting social participation • Enhancing self-efficacy including motivation, confidence, self-belief • Fostering engagement in learning	**Interviews:** Teachers, students with DHI, school principals **Questionnaire:** Teachers **Observations:** Teachers and students with DHI in classrooms.
Theme 3: **The perceived impact of ICT on the quality of teaching and professional development**	• Promoting teachers' technology and teaching skills, improving the quality of teachings and delineating ICT effects on changing teaching perceptions and nature of teaching • Enabling teachers to become more reflective on their teachings • Supporting the needs for teacher training on ICT use	**Interviews:** Teachers**,** students with DHI, school principals **Questionnaire:** Teachers **Observations:** Teachers and students with DHI in classrooms.
Theme 4: **Facilitative and hindering factors for the use of ICT**	• Lack of support from the school administration • Lack of support from the Ministry of National Education of Turkey • Lack of in-service teacher trainings and knowledge in ICT use • Challenging structure of Turkish Language • Time spent on material preparation • Being digital natives	**Interviews:** Teachers, students with DHI, school principals **Questionnaire:** Teachers **Observations:** Teachers and students with DHI in classrooms.
Theme 5: **The features of Dikte and Dikte-produced and stored teaching materials**	• Material production • Material storage • Nature and style of Dikte materials • Flexibility of Dikte use • Transcribing performance of Dikte • Dikte mistranscriptions • Suggestions for future design • Challenges of implementing Dikte • Conveying audio-visual teaching simultaneously	**Interviews:** Teachers, students with DHI, school principals **Observations:** Teachers and students with DHI in classrooms.

Main Theme	Subthemes	Method of data collection and participants
Theme 6: **Efficiency of Dikte on note taking**	• Decreasing the amount of time spent on note taking • Providing professionally taken classroom notes	**Interviews:** Teachers, students with DHI, school principals **Observations:** Teachers and students with DHI in classrooms.
Theme 7: **Dikte effects on curriculum development and oral language use**	• Contribution to curriculum development • Books beyond the academic levels of students with DHI • Supporting oral language with Dikte	**Interviews:** Teachers, students with DHI, school principals **Observations:** Teachers and students with DHI in classrooms.
Theme 8: **The perceived advantages of Dikte**	• Enabling the students to test their hearing skills • Supporting student emotions	**Interviews:** Teachers, students with DHI, school principals **Observations:** Teachers and students with DHI in classrooms.
Theme 9: **Dikte speech training module**	• Speech training with teachers • Dikte effects on the speaking skills of the teachers' • Trial of Dikte speech training module with students	**Interviews:** Teachers, students with DHI, school principals **Observations:** Teachers and students with DHI in classrooms.

Table 7. Themes and data collection methods

The following sections detail the themes and corresponding subthemes which were delineated through data analysis.

Theme 1. Presentation of ICT materials

This theme draws together the general and specific ICT materials that educators and students use in Turkish special education schools. The first interview questions for the teachers intended to identify the specific ICT materials currently used in the classrooms, and unpicked two categories of ICT materials. The first was "the use of ICT materials for audiological support" and the second was "the use of ICT materials for visual support" including hearing devices, FM systems, sound amplification materials as well as video/picture and sound recording tools. For visual support, the reported tools were pictures, cards, graphics, texts (written materials), charts, animations, vocabulary charts, cartoons, posters,

and computers. In addition, ICT devices that facilitate the hearing features and technical effectiveness of FM systems were examined under this theme.

i. Use of ICT Materials for Audiological Support

Interview data showed that hearing device as a part of audio support material was considered crucial for proper sound transferring. Interviewees highlighted its significant role in transferring the sound signals to the students with DHI that in return enabled them to teach verbally. In detail, teacher 4 stated "For my students, it is nearly impossible to hear my voice without using hearing devices, so I have to check each time whether or not their devices work prior to commencing teaching." This view was also echoed by teacher 2 as "using hearing devices is at the heart of our teaching, since we adopt oral teaching style in the classrooms. Therefore, we have to make sure each student can hear up to an acceptable level via hearing devices."

Observational data confirmed that hearing devices were used by all students without exception, and the teachers confirmed their working status at the beginning of each lesson. There were some cases where problems with hearing devices emerged during the lessons due to dead batteries, broken parts and/or unwillingness of the students to wear them. For instance, in one incident, a student refused to wear a hearing device due to distorted sound quality. The responsible teacher, thus, sent the student to the school unit responsible for hearing device maintenance.

The second form of audio support was the FM system, which was usually carried on the teachers' necks, and transmitted teachers' voices to the hearing devices worn by the students. This system uses a specific channel similar to a radio channel to transfer voice, to which each student's hearing device is tuned. The data from interviews revealed that FM system was an important component in audio support for students with DHI, in addition to allowing great physical flexibility for the teachers in terms of attaining classroom management strategies specific to the needs of their students. Teacher 14 emphasised the flexibility in movement afforded by the FM system as: "I am able to walk, turn my back, look different directions during my teaching, as the FM system enables my students to hear my voice freely without relying on lip reading or looking at my face all the time. However, without the FM system, I have to face them [the students] and my voice has to be directed to them to allow better hearing. So, I use the FM system all the time." Teacher 3 addressed the capacity of the FM system for eliminating outside sounds which were distract the main sounds received by the students by stating that "I think the FM system is very important for supporting audio transferring because it eliminates outside sounds which disturb the students most."

Due to the recent advances in audio support devices such as the FM system, the interviewees suggested that sound amplification systems gradually became useless. For example, teacher 12 emphasised that "In the past, we [the teachers] used this [sound amplification] more often, but we do not need it any longer thanks to the FM system."

Other audio support devices included TV/video as well as devices recording video/picture and sounds. Each classroom had a TV/Video system. However, the frequency of utilisation of such devices varied in each classroom. The majority of the teachers (65%) reported using the system at least sometimes, whereas a striking 15% had never used such systems. These findings were also corroborated by teacher 8: "I try to use computers more often than TV and video because the programmes included in TV and video formats are very limited and old fashioned." According to the observational data, TV and video programmes mostly involved cartoons and listening programmes, and hence the students did not always find them interesting. In fact, one student complained during a session stating that they watch the same things over and over again.

The purpose and prevalence of ICT usage for audio support showed varying views depending on the specific topic and activity. For instance, teacher 8 indicated: "I use sound and camera recordings only to enable the students to hear their own voices, but for nothing else." Additionally, teacher 7 explained "Nowadays, students try sound recordings with their smart phones, so I ask them to present those things [recordings] in class." In parallel with this, student 5 pointed out: "I personally have a smart phone. I really like it because I am able to make camera recordings and calls, and even sometimes record my friends' voices."

Classroom observations revealed that the efficiency of camera and sound recordings were rather low, a condition possibly explaining why the teachers and students hardly ever used them in lectures. There were only a couple of occasions where the students shared sound and video recordings with smart phones as a part of classroom activity. For instance, a science teacher assigned homework to the students which asked them to record two animal sounds which they could find in their homes or neighbours, and then bring the recordings to the classroom to share with the others and allow the other students to guess the animals the recordings represented.

ii. Use of ICT Materials for Visual Support

The different ICT materials used for visual support could be summarised as pictures, cards, graphics, texts (written materials), charts, animations, vocabulary charts, cartoons, posters, computers to visualise teaching topics. The interviewees emphasised that visuals were for supporting the comprehension skills of the students. A variety of perspectives were expressed. For example, teacher 8 expressed that" I mostly use visual materials like graphics especially in Turkish Language class showing suffixes and prefixes, etc.", while another remark from teacher 2 was " I try to show pictures of almost every vocabulary word by using computers to improve their [the students'] understandings" along with a

comment from teacher 13 " I use visual-based games such as vocabulary games, sentence completion, and word crossing; they are very effective tools for topic comprehension by the kids topic[the students]."

Observation data also suggested that the use of visual materials was quite common in the entire school. Several different forms of visual materials and devices were placed throughout the school, on the walls of the classrooms corridors, cafeteria, library, and dormitory. These visual materials were designed in various styles, some of which included colourful posters and pictures, large printed texts, word definitions placed under or near the graphics, charts or pictures; large stickers showing directions of specific items such as FM system materials, computer items, textbooks, written and personal materials storages, step by step definitions of how to clean hearing devices and start the students' FM system, as well as sign language illustrations for Turkish letters. Observational findings underlined that visuals were useful for these students, and the teachers had to be prepared in relation to their students' needs. Body language, gestures, and sometimes sign language were used by the teachers to steer students' attention to the visual materials in the classrooms. While using visual materials, such as explaining the learning objectives of stories as in picture format, the teachers seemed to be more organised. Moreover, in some classes, the teachers printed out big and colourful charts of the most important teaching topics of the day and placed it on the board where they could be seen by the students all the day. In doing so, the teachers aimed to allow the students topic to visually follow the sequence of the lecture.

iii. Facilitating Hearing

The main words which were unpicked regarding facilitating the hearing of students with DHI were hearing devices, the FM system, computer supported hearing activities, and any ICT tool used to support the hearing. Interview questions on the role of FM system as a part of ICT in education of students with DHI elicited several responses from the teacher interviews. At the beginning, Teacher 16 provided a detailed explanation as follows: "some of the students use it [FM system] well, but there is a big difference between students who got cochlear implant in the first grade and students who got it later. With the FM system, the students hear sounds digitally instead of naturally. I mean the FM system translates sound signals digitally into the hearing devices of the students, and we can change its sound quality. The effectiveness of the FM system depends on the hearing level of the students, because for students with severe hearing loss, even if the FM system is on, I sometimes need to repeat the same words many times'.

Other teachers also expressed similar views, especially in regards to the length of time the FM system has been used. For instance, teacher 12 mentioned "I use the FM system but it has been just recently given to me, so we are quite new users. My students began discriminating sounds; for example, they can discriminate the sounds of the objects and animals." Similarly, teacher 2 added "The FM system is actually new for our school, it is connected to the hearing devices of the kids, and I think it is definitely effective for them to distinguish many different sounds and have access to the sounds in normal life. I

wish we have had it long before." Additionally, teacher 5 approached the issue by saying, "I think the most effective one is the FM system. Through it, the students are able to hear sounds. Even though they do not understand most sounds, it [FM system] has a crucial importance, as language development is a slow progress. The FM system expands their world of sound."

Another response to this issue was made by Principal B, who mentioned: "Since we have begun using the FM system, the motivation of teachers and students [to use the FM system] have, I think, considerably increased, because they are able to hear a clear sound from the FM systems, and I can see this effect on the faces of the students."

iv. Technical Effectiveness of FM System

Overall, students pointed out that they were in favour of using the FM system in the classroom, and emphasised its high technical effectiveness. Since the main users of this system were the students, the interviews questions inquiring "How do you like the FM system?" "Do you think it is effective" and "How do you see its effectiveness?" reflected critical insights. The FM system encouraged the students and the teachers to use ICT resources often due to its advantages in good-quality sound transfer. For instance, student 10 remarked: "It has been 1.5 years since I started using FM system in my classroom. It is very effective. I can hear clearly; because my hearing loss is 70%, I can hear better than most of my friends. I got used to it." Another comment was: "I can hear better because our hearing devices and the FM system are much better than the previous ones. I can distinguish sounds better now" (Student 3). Two students stressed the relatively short length of time of the adoption of FM system in this school. As one explained: "We [the students] were given the FM system just at the beginning of this year. I am not used to it, but it provides very clear sounds. I began to recognise many different sounds in the classroom that I did not hear before" (Student 4), while another one stated "Before the FM system, I was missing a lot of sounds and could not hear the teachers well. We got the FM system just this year, like 5 months ago. I now hear better and even distinguish some of the difficult sounds from each other" (Student 6). From these comments and the researcher's observations, it was identified that some classrooms and teachers began to use the FM system before others. The first group was used to test the FM system's quality and usability in this school. This was around one and half years ago before the conduction of the interviews (April, 2014). The remaining classrooms were provided the FM system at the beginning of the school year in September 2013. Therefore, the interviewed students reported different exposure times regarding the FM system usage.

The school made it obligatory to use the FM system in each classroom, and during the whole period of teaching (only one teacher [teacher 6] did not have the FM system due to budget issues). The teachers had to turn the FM system on at the beginning of each lesson and check whether all students could receive the sound signals properly. The teachers wore the device on their necks. The FM systems worked effectively up to 25 metres, which provided flexibility of movement around the classroom for the

teachers. Normally, the teachers should face to the students while speaking, and there has to be good lighting in the classroom to enable the students to see the face and lip movements of the teachers and other facial expressions. By using the FM system, the teachers and students acquired more freedom in the classroom because as the students could clearly hear the teacher's voice. Students exhibited different emotions and perspectives on the FM systems. In one occasion, a 7th grader female student told her teacher that she was happy not to hear background sounds, and their hearing devices could not eliminate these disturbing sounds previously. The teacher explained that this was because the FM system eliminates outside sounds to a large extent and sends only the teacher's voice to the hearing devices of the students. However, there were times when the students stated that FM system was not making any difference for them regarding their hearing. A technician from the school also investigated this issue since the FM system has been on trial, and reported that "those who were complaining about the FM system effectiveness were mainly students with severe or relatively high hearing loss."

Theme 2. The Role of ICT in Developing Educational Capabilities, Social Participation and Motivation of Students with DHI

The data concerning the perceived role of ICT in developing educational capabilities, social participation and motivation in students with DHI raised important issues. These issues are examined under different subthemes, such as "improving academic skills of students with DHI", "promoting social participation", "enhancing self-efficacy including motivation, confidence, and self-belief", and "fostering learning engagement," all of which were developed using the data from interviews, questionnaires and observations. Overall, the results suggested that ICT was perceived to be influential in developing the educational capabilities, social participation and motivation in students with DHI through various channels.

In relation to academic skills, different skills such as learning, writing, memorising, researching, and reading were emerged in the interviews. Technological tools such as computers, laptops and smart phones were seen as supportive in improving the academic skills of the students. With regard to this, principal B reported that "I see that some of them [the students] use smart phones, laptops and tablets, etc. So they are good with technology. This directly affects their academic skills too, because they learn how to search information online, download, open and utilise it," while principal C indicated that "some of our students can use computers well for activities such as watching movies, online searching, and playing games. This is a good way to be exposed to new information for them. Also, our students try to use smart phones to communicate, which will definitely help them to speak and write better."

The teacher interview data probed into the improvement of academic skills of students with DHI through the visualising of the teaching materials via ICT. Visualisation through ICT was considered to be crucial for developing the academic abilities of students using visual channels. In fact, opportunities for visualising teaching materials through ICT became increasingly important in teaching. For instance, one

science teacher (Teacher 4) stated "I use visuals for example in explaining the digestive system, dispersion or solution. I first try to find and show the pictures online, because it is relatively faster than printing everything beforehand and bringing the handouts to the class. Then, I prepare the lab materials to practically experience these activities. For instance, when I explain photosynthesis, I show videos, short clips and pictures, also lets say how chlorophylls work in the nature etc., so I basically try to visualise things and implement them in the lab as much as I can" Similarly another science teacher (Teacher 6) indicated that "I mostly use visual materials such as pictures, graphics and charts by finding them online. For example, for vitamins, I open Google and show pictures of vitamins, so they remember things better. Otherwise, they [the students] forget very quickly."

The teachers described the use of visuals in improving the comprehension skills of the students as teacher 11 inserted that "I try to show pictures of almost every vocabulary or teaching topics. For example, they [the students] know what the umbrella is as in picture, but do not know how to write it. So, I match picture and its written component, and then the teachings make sense for these students. This is the only way that they remember teachings. I mean visuals, especially suffixes and prefixes are problematic because Turkish sign language is limited in expressing these." Similarly, teacher 8 said "The reason behind using visuals extensively is because these students' hearing impairment …they do not comprehend the topics as we do. So visuals make comprehension easier for these students and generally effective especially in my class. As you see there are cartoons placed on the walls explaining the features of Turkish Language such as the construction of suffixes, word endings and others. These students are able to understand mainly through these visuals. Also, they study these materials on the wall over and over, when they forget things, or to refresh their knowledge."

The data from interviewed teachers also demonstrated role of ICT in the development of students' vocabulary. In detail, the data indicated that computer games, visual graphs, pictures and other sorts of visuals were effective in vocabulary learning, as evidenced by the following interview reports: "I have a computer game, it matches pictures and words of the topics, so my students try to learn and memorise all of the words in this game to beat others and to be champion in the class. So far, they have learned 200 vocabulary words with this game in this year (in 4-5 months). So it creates a learning platform and competition area. The students learn faster and memorise the covered topics better with ICT materials" (Teacher 2), and "When I conducted a research about how many words secondary levels students [sixth graders] were using, the result was between 250-300 words. They were only able to use these vocabularies in their lives. Today they know around 2000 words. I and some of other teachers have been using computers, applications, visual graphs, vocabulary charts, paintings, pictures, colourful visuals demonstrating vocabularies, etc. So, when the students began seeing and playing with these materials, learning happened automatically. This is how ICT has affected our students' learning" (Teacher 14).

Questionnaire data supported these perspectives. All the teachers participating in the questionnaire agreed on the effectiveness of ICT use in developing students' academic skills as shown below:

Perceptions on the effectiveness of ICT in academic achievements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think ICT-supported education will be effective for the student academic achievement	20%	80%	0	0	0

Table 8. Perceptions on the effectiveness of ICT in academic achievements

Observation data on the importance of ICT use for supporting vocabulary development showed that ICT tools have a strong positive influence on the students' vocabulary learning skills. On one occasion, a teacher used software called "Multimedia Builder", which combined the picture and sign language video (with audio component) representing the same vocabulary. When the student click on a word, a picture and a sign language video appear on the right side, as shown in Figure E below.

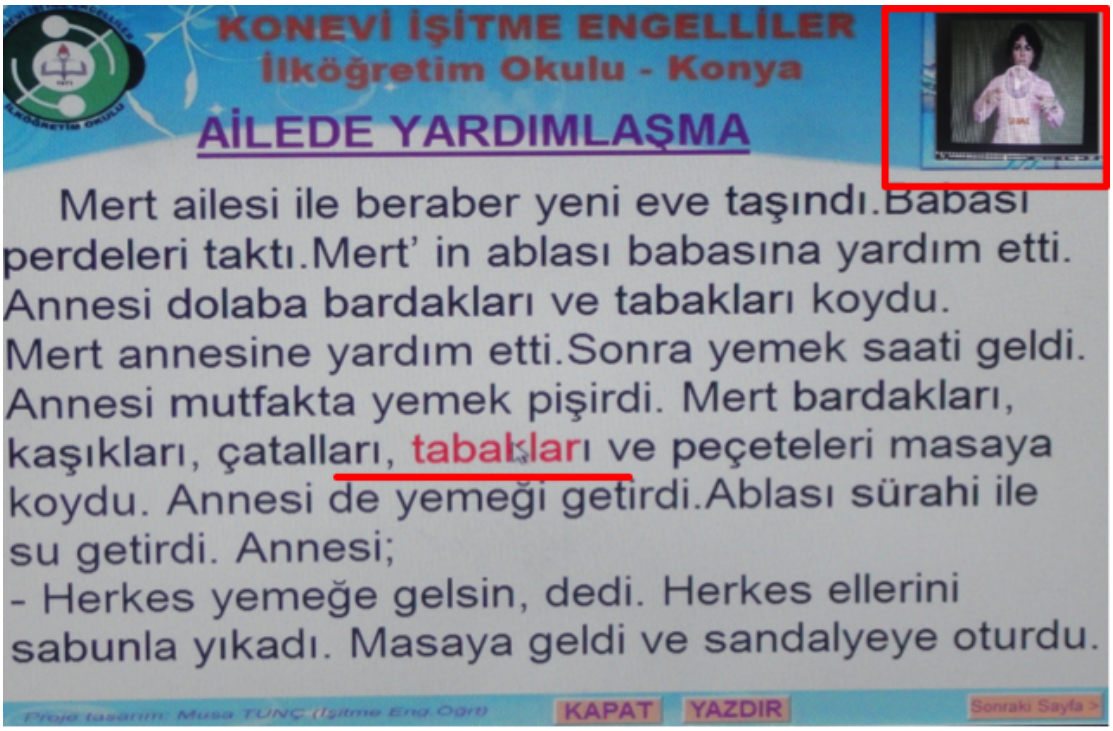

Figure E: Sign language video and picture demonstration

This figure shows that when click the word "tabaklar" coloured in red, a sign language video and picture demonstration of the word appears on the top-right corner.

The advantages of a 'Multimedia Builder' program were stressed by one religious studies teacher (Teacher 11), who stated that the students find the program very easy to use. Additionally, the program

was effective for vocabulary development as it provided sign language videos as well as pronunciation allowing the students to learn new words in an audio-visual way. Moreover, the students were able to use this program offline (without internet access) in any location. This was supported by student 8 who pointed out that this program offered the opportunity to access information any time at any place, allowing the students to study as much as they want.

Students emphasised the effects of visuals on the their academic achievement which ranged from learning new vocabulary to enhancing comprehension skills. For instance, student 4 pointed out that "I want to see everything visually, I really like fun games and learn better with them," while student 5 commented that "Last year, my teachers were only using the computer and projector system. This year they allow us to do something on computer. There is a program and when we select a word with the mouse, its picture and sign language interpretation appears on the screen. This is a good way to learn new vocabulary words. In mathematics, when I know the answers faster than others, a little man on computer jumps higher and I get points. So we enjoy using computers." This is consistent with another statement by student 9, "When the teachers use videos and games, we do not get bored. For example, we draw pictures, learn new vocabularies with pictures and write them. With computers, we have fun seeing pictures, word games, and chatting. Importantly, students' responses suggest the central role of visualising teaching materials via ICT materials in supporting comprehension skills. For instance, student 10 indicates, "Our teachers try to explain teachings with pictures. It is fun. Pictures are better than our books. They [the books] are boring. Also, most of my friends do not understand the texts in our books, but when teachers use pictures, the texts are easier to understand." Similarly, student 2 said "I can learn better with visuals like pictures and videos not from notes."

Another subtheme was ICT use in promoting students' social participation. Overall, the data showed positive views, emphasising how ICT usage increased students' social participation in classroom activities. In one case, teacher 5 explained "Another thing is computer-based games and activities. The students like to experience different games where they engage more with each other and have fun. Especially when I provide a prize for the winner of some activities, the participation and their [the students'] excitement increase."

The data from interviewed teachers and students regarding ICT effects on motivation to learn and practice teaching materials illustrated the importance of motivation for learning as "When it comes to ICT, these materials capture their [the students'] attention, motivate them and provide fun. Our biggest need, I guess, is motivation. Our students can be easily distracted and lose their attention" (Teacher 5). Teacher 15 also acknowledged that "…the students pay more attention to classroom activities. They are more motivated and can easily focus on topics. They become eager to participate. ICT helped us to take down monotonous classroom environment." In supporting a similar view, Teacher 1 said "In mathematics I make number blogs and present them as a game because our students like it

better this way. They get more concentrated. Our students lose their concentration if you only use verbal conversation or traditional knowledge transferring methods." Teacher 11 discussed "They [ICT tools] are especially important for my class for language development. Computer programmes enable better student concentration on the topics, through resources such as pictures, videos, sounds, cartoons, you name it. When I use such materials the kids become more excited to learn."

In the same vein, the principals pointed out that adoption of ICT positively impacted student motivation. Principal 2 commented "I can see that when our students use different ICT tools such as software games, they enjoy more. They like to play games. I mean any kind of games, the more they play better they become motivated and the more eager they become to learn more."

In parallel, observation data supported that the students showed increased attention towards computer activities, games in different contexts, watching animations or videos of learning topics. Especially when there was a new game or activity that was not done before, the students seemed more excited and motivated to listen to the teachers. However, student enthusiasm was dependent on factors including but not limited to the topic, type of activity, attitude of the teacher as well as the delivery method of the lecture. For instance, in a mathematics class, introducing an online game designed for division did not attract the attention of any student in the classroom; rather, the students were unwilling to engage with the material. In contrast, all students were eager to participate in a science class where the teacher grouped students to compete against the computer in an online game about human body parts. In addition, the use of ICT could foster classroom engagement in students by providing technology-supported classroom activities often described by both students and teachers as "fun, better, not boring, and exciting." In support, some interviewees argued that "We watch videos; our teachers try to explain teachings with pictures. It is fun. Pictures are better than our books which are boring," and others stated that "When my teacher gives writing tasks, I easily get bored and have hard time of writing, …I really like fun games." (Student 2) or "When the teachers use videos, games etc., we do not get bored" (Student 9).

Teachers' perceptions on the effectiveness of ICT in motivation skills	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think, ICT-supported education will improve students' motivation about lessons.	5%	85%	10%	0	0

Table 9. Teachers' perceptions on the effectiveness of ICT in motivation skills.

Theme 3. The Perceived Impact of ICT on the Quality of Teaching and Professional Development

The perceived impact and the potential role of ICT regarding the teaching quality of special education teachers as well as their professional development were analysed. The data from interviews,

questionnaires and observations indicated an improvement in the technology and teaching skills as well as the quality of teaching skills of the teachers, a shift in the perception on the best methods for teaching students with DHI, and lastly, an increased reflexivity of teachers on both their teachings and required training for ICT use.

Interviewed teachers pointed out that engaging with technology enabled them to evaluate their own teaching skills. For instance, teacher 1 reported that "while you [the teachers] are preparing these materials, you also learn, criticise, plan and evaluate what you have achieved or missed so far. Hence, when I come to class, I am quite prepared. Also even if you buy a program or activity for the students, you have to check its academic level, appropriateness of the content, etc., so you need to still work".

Additionally, the majority of the teachers were in favour of receiving better training for utilising ICT resources more effectively in their teaching. In detail, teacher 5 emphasised: "I need to learn more and receive professional help to be better [at technology usage]. I am not good at preparing materials at home".

The teacher interviewees discussed changing teaching practices as a result of ICT use along with teacher preferences for ICT support with a particular focus on visualising teaching topics. Arguably, ICT-integrated teaching model has been effective in shifting the teaching focus away from traditional teaching models. This view was echoed by many participants. For example, teacher 4 reported that "The materials such as lab tools, books and papers should be prepared before the class. When I conduct an experiment with ICT tools, in fact, my job becomes easier, since facts verbally are relatively more difficult and sometimes not very effective. Especially for our students, the lessons should be presented as much as possible in visual forms. Also, in my classes this is almost obligatory. I use the computer to find videos and pictures of the topics, then explain the necessary parts, give some verbal information and later on implement it by myself. I think this is the right method to educate our students. Similarly, teacher 5 discussed "For me, teaching topics with ICT is very effective. Indeed, these tools make my teaching easier than traditional teaching. Because, in traditional model, I have to practice and teach everything by myself and I have to be a good point of interest so that my students will concentrate on me, which is difficult. However, when I use ICT, most of the concepts are introduced visually and I just explain them." On the contrary, some arguments by teacher interviewees were raised as teacher 11 argued that "I think, for me, ICT use is not that much effective on changing my traditional teaching model, because it depends on the subject of teaching as well, I feel that I do not often need to change my teaching model, but I still use ICT, what I do is to integrate ICT in my traditional teaching model, I do not let ICT to take control in class. So, I think, it supports student-centred model, but this progress is very slow at the moment".

Discussions on improving teaching quality via ICT predominantly revolved around creating a pool of teaching materials for various purposes and assessing the academic difficulty level of the lessons

to make sure they were appropriate for students with DHI. In detail, teacher 14 indicated: "I think the first benefit [of using ICT] is helping teachers to come to the class ready. We would have prepared materials to use, would have a material pool, and we can categorise the prepared materials according to the students' academic levels. And hence, each teacher can benefit from this material pool. In mainstream schools, when a teacher enters a classroom he or she will be ready and know how to convey the teaching topics just by studying 3-5 minutes beforehand. However, we as special education teachers are different; we have to evaluate if the topic can be acquired easily by our students with DHI, and we should consider their academic level. We have to think 4-5 different approaches or strategies at least, so we have to be prepared before the class. The more we use ICT materials, the better we become at teaching in the classroom." Furthermore, teacher 8 reported that "the teacher becomes more knowledgeable about the topics and corresponding delivery methods, since we also learn and educate ourselves while preparing required computer files or programmes.

The questionnaire prompts " the use of technology in education improves the effectiveness of my teaching", "it is important for me to use more ICT resources in my teaching" and "I am aware of the advantages of ICT in teaching" handled this theme. The views of the teachers are detailed in table 10 below.

ICT effectiveness in teaching	Strongly Agree	Agree	Neutral	Disagree
The use of technology in education improves the effectiveness of my teaching	15%	65%	20%	0
It is important for me to use more ICT resources in my teaching	30%	60%	10%	0
I am aware of the advantages of ICT in teaching	10%	50%	30%	0

Table 10. Teachers' perspectives about ICT effectiveness in teaching.

Theme 4. Facilitating and Hindering Factors for the use of ICT

The interviewees' responses to the interview questions; namely, 'what are the factors facilitating ICT uptake in classrooms?', 'what were the main distractors faced while utilising ICT?', 'what sorts of barriers have you faced during ICT implementation?', and 'what are the most prevalent ICT barriers for your teaching in this school?' as well as data from questionnaires and observations helped the framework of theme 4. The following issues as the support and barriers of ICT utilisation in classrooms were emerged.

(i) Supporting factors: Technological proficiency of young people

(ii) Barriers:

a. The lack of (1) adequate support from the Ministry of National Education of Turkey in relation to producing and distributing educational materials, (2) in-service teacher trainings, (3) teacher proficiency in ICT utilisation and knowledge (4) school administration support and availability of budget
b. Length of time spent on the preparation of ICT-compatible lecture material
c. Idiosyncrasies of Turkish Language

The following sections will detail these issues.

(i) Supporting factors

Teacher interviewees reported that in the modern world the technology skills of students were well developed, and hence the students can successfully use technological devices in their daily lives as well as in classrooms. From the teachers' viewpoint, the younger generations were born into technology and have grown up with it, which provided them with the knowledge of using it for their own benefit in different circumstances. Teacher 1 highlighted that "Our students like to engage with technology even in relatively poor areas of the city. Some of them have smart phones and computers, and my students need to use technology due to their hearing impairment. They have no fear of using technology and I cannot keep them away from technology. So, since they are good at it, I can easily gain their attention during a computer-based learning activity, they easily do it."

Similarly, reports from observation supported that being 'digital natives' and adapt at utilisation of technology enabled the students to exhibit good skills. For instance, in a technology design lesson for 7th grade students, the learning objective was to download a cartoon-making program, run it on the computer, and create individual folders for each student. Another task was to choose a male and female character, form a bubble near it and create conversation dialogues. After the road map (i.e. schedule) for the lesson was introduced to the students, most did the tasks without waiting for further directions from the teacher. Most students thought the task was easy. Even the students, who had not used a similar program before, quickly learned to navigate it. At the end of the class, the teacher reported that around 10-15 years ago, most secondary school students did not even know how to start a computer or use technological tools in classroom activities.

(ii) Barriers for the utilisation of ICT in classrooms

Interviewed teachers and principals reported the lack of support from the MONE as a hindering factor for ICT use. Teacher 12 reported that "We, as teachers, prepare our own materials. There is no material support or help from MONE regarding this; everything depends on the teachers' skills and choices. Of course, this is not a good thing; every teacher might do different activities. Sometimes

principals and teachers do not know what the other teachers are using in the classrooms. I wish MONE provided ICT materials for us." Similarly, teacher 13 stated "There is no material support from MONE for us. I wish did, because we spend a lot of time to prepare materials." Also, principal B reported: "There is no program offered by MONE regarding ICT, but we have some small projects or advertisements coming from outside companies. Educational organisations such as private companies selling ICT products, private schools selling some books, games and software come and introduce their products; we may buy some of them depending on our needs".

Issues regarding lack of MONE support were also identified during the observations. Indeed, besides basic textbooks and computer software to run essential programs, the classrooms did not have any educational software supplied by MONE.

The interviewed teachers raised issues around the lack of in-service teacher training including insufficient support for ICT utilisation, highly theoretical approach rather than providing practical information. Teacher 5 stated, "I have to say that there is no specific course or training about ICT material preparation. But, it is included in in-service teacher trainings. To be honest, (in in-service trainings) we are usually overloaded with theoretical information, no one likes it. We want to see more practical trainings, obtaining materials and learn how to use them (in classrooms)". Similarly, teacher 14 argued "Regarding ICT learning, I do not prefer attending in-service trainings, because they are usually informative about very basics of technology and ICT, but I want to see how practically I can use them in my teaching, especially considering our students with DHI, it has to be much more better organised and utilise some ICT materials for us".

The questionnaire data asking 'attending seminars', 'obtaining extra support (computer course)', 'attending in-service technology trainings' and 'developing in-service teacher ICT trainings' reported various perspectives regarding in-service teacher trainings. The findings are demonstrated below in the table.

Activities for professional development of teachers	I strongly prefer	I prefer	I am not sure	I do not prefer
Attending seminars	30%	40%	25%	5%
Obtaining extra support (computer course etc.)	15%	55%	15%	15%
Attending in-service teacher trainings	20%	50%	10%	20%

	Very Important	Important	Neutral	Not important
Developing in-service ICT teacher training	10%	70%	20%	0%

Table 11. Teachers' preference for different training methods for professional development

Another hindering factor was the teachers' lack of knowledge in ICT use. The relatively quick advancements in technology and the teachers' ability to follow fast-paced advances were provided as the root for the lack of knowledge in ICT. Teacher 12 felt that "Not all teachers use computer effectively, some do not even use ICT or some may not even know how to draw pictures (referring to a paint program). So, we have to be provided with teaching materials and be trained in this respect. For example, I can use the computer very well, but I cannot draw charts or pictures. One of our teachers is very good at drawing cartoons to convey teaching topics, and he is very effective in class. So, there is a negative side of ICT if the teachers are not good at using it." Teacher 8 stated "I think, it really depends on the teachers' ICT or computer skills. Personally, it is easier to prepare teaching materials today compared to the past due to technological developments. So, the preparation process does not take lots of my time. However, I cannot say the same thing for other teachers who are not skilled at computer usage. For them, even very easy things can be quite time-consuming and difficult to handle." Table below shows that teachers' lack of knowledge in ICT use was a hindering factor as 30 percent strongly agreed while 65 percent agreed.

Teachers' perceptions about the lack of ICT knowledge of teachers	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Teachers' lack of knowledge about technology usage	30%	65%	5%	0	0

Table 12. Teachers' perceptions about the lack of ICT knowledge

Limitation of technology access in the school including computers, printers, and scanners were not mainly considered as barriers in ICT use and various views emerged from teacher interviews and questionnaire findings. Teacher 9 discussed "I think, we have enough technological materials like computers, Internet, printers etc. I think, how we make use of these tools is important, blaming lack of resources today in our country is not very realistic". Also, teacher 3 argued "today, our school has investments regarding technology infrastructure, everyone has computers and printers in the class, but we have problems with accessing technological software because we have to buy them and be able to use properly. So, I think this is not working well in our school". Regarding these issues, questionnaire findings reported consistent data compare to the data from interviews. Overall, the teachers acknowledged that the school's technological infrastructure including computers and printers were not hindering factors anymore as the table 13 demonstrates below.

In contrast, the quality of the school's ICT materials and the availability of budget to purchase ICT resources were identified as barriers for ICT uptake in classrooms from the interviews with teachers. Teacher 6 discussed "I have requested a couple of times to buy educational software, but the school could not afford to but them, because, there is money to buy computers or printers, but not mostly for ICT software". Similarly, teacher 11 argued "We have computers, that's fine, but usually we are not provided ICT software like computer games, educative software, or online activities etc. I can say that the problem is not with limitation of basic technological materials, rather it is about ICT in different formats". Consistently, questionnaire findings revealed that inefficient support from the school administration regarding ICT uptake in classrooms was a strong hindering factor as 65% of the teachers agreed (see table 13 below).

Teachers' perceptions about hindering factors in ICT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Limitation of technology access in the school	0	30%	65%	5%	0
Limitation of computer lab usage in the school	0	10%	50%	40%	0
Lack of investment for infrastructure of the school in technology usage	0	0	25%	70%	5%
Limited number of printers and scanners	0	0	0	25%	75%
Limited number of computers for teachers	0	0	0	20%	80%
Limited infrastructure of the classrooms for ICT usage	0	15%	80%	5%	0
Insufficient financial support from the school administration for ICT usage	0	65%	30%	5%	0

Table 13. Teachers' perceptions about hindering factors in ICT

The teachers considered the length of time spent for material preparation as a hindering factor for the integration of ICT tools in the classroom. Teacher 15 clarified this through the statement "It takes lots of time to prepare some of the materials. I cannot do this in the classroom, not during break times, also some of the web sites do not give free pictures. I spend a lot of time to find appropriate pictures for my students' academic and social levels. Also when I decide to do a specific activity or material, it requires a lot of time," while teacher 5 stated "I face some difficulties especially preparing

video and visuals appropriate for the age of the students. It is very time consuming." Another two comments by teacher 13 and teacher 1 were respectively "I wish we have had material support, because I spend a lot of time to prepare them" and "Preparing some of the materials take too much time; you should do it at the weekend or the day before the class." In parallel, the questionnaire findings found that all the teacher agreed (35% strongly agreed, while 65% agreed) that time spend on material preparation was a crucial hindering factor for ICT utilisation as table 14 shows below.

Teachers' Perceptions about Hindering Factors in ICT	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Too much time spent on material preparation	35%	65%	0	0	0

Table 14. Teachers' perceptions about time spent on material preparation as a hindering factor in ICT

Data from interviews and observations led to some unexpected findings regarding the idiosyncrasies of the structure of the Turkish Language. The data suggested that teaching the linguistic structure of the Turkish language was quite complex and the availability of ICT resources for this specific topic was very limited. In addition, significant problems about finding specifically produced ICT materials for teaching the linguistic components of the Turkish Language such as grammar and syntax were reported. Teacher 8 claimed "I think the structure of Turkish Language is a big burden and difficulty for us to teach it with even different ICT resources, let me explain it more. For example, one word can take tens of suffixes and each suffix changes the meaning. It is easy for us to understand this, but these students become frustrated when they try to learn Turkish Language."

Some Turkish words can take more than 10 suffixes and each suffix can change its original meaning. During a Turkish Language lesson, the teacher wrote the word 'olmayacakmışçasına' on the board. The root of the word is 'ol' which means "to happen" or "to be" in English, and suffixes are '-ma', '-(y)acak', '-mış', and '-çasına' providing the word the overall meaning of 'as if it were not going to happen.' The suffixes and their corresponding meanings are broken down in table 15.

Language	**Root**	**Suffixes**			
Turkish	Ol	-ma	-(y)acak	-mış	-çasına
English meaning	Nominative state for to be/to happen	Suffix for negation	(y): buffer letter - acak: suffix for future tense	Suffix for pluperfect past tense	Equative suffix giving the root the meaning "as if"

Overall English meaning	"As if it were not going to happen"

Table 15. Turkish and English comparison of a word in terms of suffixes.

The structure of Turkish and English Languages differ significantly as Turkish in an agglutinative language. Unfortunately, to date how this can be accommodated by ICT is unclear. In the provided example, which the eighth graders were expected to comprehend, one Turkish word corresponds to eight English words note that most suffixes (e.g. -çasına) doesn't have a stand-alone meaning and they only become meaningful when attached to a root word. Therefore, teachers found it challenging to explain these suffixes to students with DHI.

According to the interviewees, Turkish Sign Language (TSL) was a limited language which is insufficient to meet the complexity of teaching the Turkish Language (TL). Overall, main argument was about signing suffix and prefix requirements of TL. Principal B reported "Our sign language [TSL] is a limited language, because you cannot sign some of the words or suffixes, especially suffixes. So how can we teach each suffix without even signing? This is bad luck." Teacher 10 discussed "I find it very difficult to sign words that take more than 3 suffixes, it is unpractical, there are signs for words, but suffixes change the meaning, we have to find different solutions because TSL does not work in signing suffixes". Another strong argument was "I had no way to sign many Turkish words with some suffixes and prefixes in 25 years of my teaching experience, I have not also seen any students who can properly understand long Turkish words like some suffixes. Our language (TL) is a truly extreme language to be signed" (Teacher 16). Considering the students' viewpoint, there was no data obtained regarding this issue in student interviews.

Observation reports have also acknowledged that there were many times that the teachers could not sign some words, had difficulties in explaining suffixes (as the words in table 15 above), passed the words without signing by trying to explain in oral or pictures. The teachers' behaviours regarding TSL was not usually positive especially when signing long words, however, in signing basic words, they did not seem to be highly complaining, rather using it as a working language.

Theme 5. The Features of Dikte and Dikte-Produced and Stored Teaching Materials

This theme examined the role of Dikte in material producing and material storage as well as the nature of the produced materials terms of how the features of Dikte (i.e. text and audio formats) could support the production of materials. The topics presented in this theme were:

(i) Storing Dikte transcriptions and audio recordings,

(ii) The quality and scope of the Dikte materials,

(iii) Dikte features including flexibility of usage, transcribing performance, ability to convey audio-visual teachings simultaneously,

(iv) Suggestions for future design,

(v) The challenges of implementing Dikte.

The data revealed the critical role of Dikte in producing materials in text and audio formats. Several interviewed teachers illustrated that Dikte was a supportive tool, specifically for transcribing speech into text and audio formats during teaching. The interviewees stated as follows: "After implementing Dikte for 10 weeks, I have realised that we have had tens of pages of classroom notes. I am calculating now that if we try to use it each day, let's say for one hour, we would have hundreds of pages of classroom notes which will be an amazing contribution of Dikte to the amount of materials we would have," (Teacher 2), "Dikte has a potential to make a significant effect on producing teaching and studying materials for us" (Teacher 11) and "I wish I was introduced Dikte long before, because by now I would have had hundreds or thousands of written documents and sound files" (Teacher 5).

The majority of interviewees suggested that materials produced by Dikte could be used to form a material pool which could then be shared by teachers and students. Furthermore, the interviewees emphasised the importance of permanent data collection with Dikte. In detail, teacher 6 reported "We were able to create written notes and sound files for later use; also it [Dikte] enabled us to collect lesson notes which created a small material pool." Similarly, teacher 14 pointed out "We had a chance to use Dikte to collect classroom data and create material pool". Teacher 9 stated that "it [Dikte] has contributed to my professional teaching in terms of creating a material pool (i.e. portfolio) of my teachings. I think this is important for my career." The idea of creating a material pool which would become a permanent storage of teaching materials was also discussed: "I think the print-outs and sound recordings of Dikte are a revolutionary way of recording what is covered in the classroom and creating permanent materials for later use" (Teacher 7), "Dikte documents are stored in my computer and there is no risk of losing them" (Teacher 16).

The comments by teachers and students on the style and nature of Dikte hand-outs and sound files indicated how Dikte documents were natural compared to other study materials such as textbooks. It was suggested that documents created by Dikte were more natural, concise, clear, and easy to comprehend. Teacher 10 stated "I think, Dikte documents are easier to understand compared to our textbooks, because Dikte documents explain everything step by step in a conversational style which is more natural." In parallel Student 10 stated that "It is easy to read from print outs because sentences are short and clear, not like the ones in our textbooks." The picture below shows an example of Dikte explaining topics in a natural conversation style in a science class.

Figure F. Dikte use in a class.

As the picture shows, the teacher speaks into Dikte microphone and transcribed texts appear on the board simultaneously. Dikte writes words based on where the cursor is, so in this picture, red coloured words are Dikte texts.

After two months of intensive Dikte usage, the teachers were able to evaluate its accuracy in transcribing. Overall, Dikte's performance was reported to be good. Some of the interviewers reported "Even with its transcribing mistakes, it [Dikte] was working very well" (Teacher 13), "I think, overall it is a very successful program"(teacher 10), "For the point of transcription accuracy, there were some mistakes for me, maybe % 9-10, so it was quite successful" (Teacher 3), "I am personally impressed with its performance" (Teacher 8), and "From my experiences with Dikte, I can say that it is successful at converting speech into written words" (Principal A).

One of the main concerns of the teachers at the beginning of this study was about the accuracy of Dikte's transcription facilities. This issue has been emphasised by some of the teachers who had negative experiences in the past concerning SR programmes. The experiences of the teachers were based on a previous implementation of SR programmes that mostly ended up with disappointment. These programmes were mostly basic software (easy to use and not requiring comprehensive user skills) downloaded from the Internet and used with a computer or smart phone. The initial concerns of the teachers were alleviated by encouraging the teachers to record their voices by themselves (in guidance of the researcher) for around twenty minutes to train Dikte for the most commonly used 300 Turkish words. The number of words depended on the time spent on this sound recording; the more the teachers use it, the better Dikte becomes at remembering each individual's pronunciation. For instance, each teacher created an individual user profile with his or her own name and sound recordings, and used that profile throughout this study. Overall, after taking these steps, the transcribing performance of Dikte was observed to be mostly successful, though occasional problems were encountered depending on the topic, teaching style, and the pronunciation of the teachers. Indeed, Dikte was quite successful, 95% or more accuracy in transcribing sounds into text, when the teachers used Dikte for basic story telling in Turkish Language class or in the technology design class to explain the steps of opening a folder, software or

program. However, the accuracy was lower (as low as 70%) in some cases, such as during an art class, where the teacher was explaining the meanings of technical terms about painting carpets. Dikte was considered to be unsuccessful by the teacher and students in this class.

There were other occasions where Dikte was not very successful in translating spoken words into text. In such cases, the teachers had to dictate the correct word again during teaching or at the end of the class. Teacher 2 suggested that "One of the problems is not recognising or transcribing all the vocabulary correctly; for example, when I said tükürük (saliva) it wrote as kükürük. So I had to pronounce the word again". Teacher 14 also stated that "Dikte sometimes made mistakes but I corrected them during teaching or after the class by editing the text," and Teacher 1 commented "Some of the words were written wrongly by Dikte. This was quite normal for me, I mostly corrected them after class and realised that many of these wrong-written words were basic things." The students with DHI also expressed similar views. Student 3 "There were sometimes mistakes, our teachers deleted the wrongly written words and corrected them; sometimes our teachers did not realise the mistakes but at the end of the lesson they corrected them." "My teachers corrected when there was a mistake, sometimes Dikte wrote two-three words wrongly, and my teacher deleted the whole sentence and dictated it again" (Student 8).

The teachers who employed Dikte mainly reported that they had sometimes redesigned the Dikte text files by changing text characters, underlying or highlighting some of the words or sentences, changing the colour and font sizes, and placing additional symbols to emphasize important points in the texts (see figure G below). For example, one interviewee stated that "I underlined some of the important points, coloured them differently, so the students received better looking texts notes" (Teacher 1). Teacher 16 also commented "I have edited some parts of Dikte notes after class; coloured and underlined some sentences, changed characters, etc. and then gave the edited notes to the students." Teacher 5 highlighted the adjustable features of Dikte by suggesting "I want to mention adjustable Dikte writing characters. They are great features because I used different font sizes, characters, and colours while using Dikte. In parallel, two interviewed students reported "My teachers sometimes changed the colours and characters of Dikte texts, so we were given many colourful print outs" (Student 5), "My Turkish Language teacher coloured suffixes with different colours, so I was able to distinguish them" (Student 6).

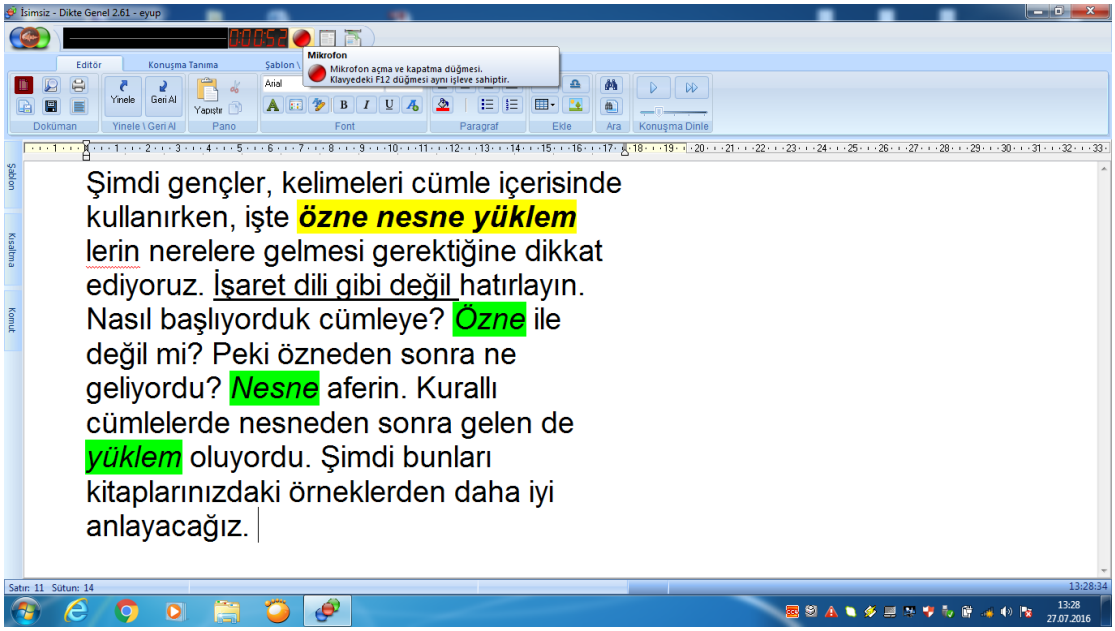

Figure G. Dikte edited transcripts.

The interviewees stressed how Dikte served as a platform for delivering audio-visual teaching simultaneously. Teacher 16 reported that "My students were able to hear and see learning topics simultaneously, I like this point of giving verbal and visual information simultaneously, and Dikte did a very good job of translating my speech" while another teacher stated "the students were able to see written versions of the vocabularies simultaneously during my speech" (Teacher 10). Along the same lines, more comments were made including "My students were able to hear as much as they can [with FM system] and see the written format of the words" (Teacher 5), "it was great for them to be able to see what was spoken in the classroom as in text format on the board" (Teacher 14). In terms of the comments about stimulating multiple senses, the interviewees highlighted that "I think it is great to combine different senses (referring audio-visual) (Teacher 8)" and "This [stimulating more senses] is what we need. I mean we have to use any material that can stimulate different senses, because our students definitely need that" (Teacher 11). In addition, teacher 2 stressed that "We often have problems with combining different teaching methods such as giving sounds and showing visuals for students to comprehend; I think Dikte was very helpful in doing so, but partly, I mean only showing the words visually".

A common feedback among the interviewees was to redesign the Dikte speech training module for future use, appropriately aligning it with the specific needs of the students with DHI. Teacher 15 suggested "My expectation from Dikte in the future is to write very basic letters as they are pronounced like whether it consists of 2,3 letters or 5 letters, etc. I mean, Dikte predicts our spoken sounds and translates them into a word, and therefore it makes mistakes, so it cannot be used for students with low speaking skills. However, for those who are good at speaking, it can be an effective tool for developing better speaking and pronunciation skills." Similarly, teacher 16 commented "How I want to use it in the

future is that if Dikte can write single letters as they are pronounced, it would be very effective for my students, because writing word by word is great but we need to see the individual letters, as well." One respondent emphasised that "Dikte can be especially helpful for students who are good at speaking. For example, if they are able to sound out some specific words, Dikte can help them to practise their speaking. I personally want to use Dikte in this way in the future" (Teacher 8). One further recommendation was that "If we can use Dikte in a way that the students can train their speaking skills, it would be great. If Dikte can do it, I think it can be much more effective" (Teacher 14). The last comment was made by teacher 1 regarding to developing Dikte to include specific vocabulary items that are not already included in the speech therapy module of Dikte "I think it [Dikte] needs to be redesigned to include more educational activities such as a speech therapy module for our students. We should then be able to introduce our own vocabulary into Dikte".

There was only one comment on the school budget for Dikte program, stating that it is 'not a big deal.' Also, it was indicated that having Dikte would be good for the school in giving it a competitive advantage considering that other schools for students with DHI around the country do not have a similar system. In support of this view, principal C stated "In terms of the budget, for 16 teachers in secondary level, we need around 18,000 Turkish lira (equal to 4.500 GBP) to buy Dikte for all teachers. So it is not a big deal, we can use outside resources to buy them as well. For infrastructure, it would be nice to have such a program for our school, because I think no other deaf or hearing-impaired schools in Turkey has this program yet.'

Another challenge for implementing Dikte was the transition from a traditional classroom set up to an ICT-based environment. The teachers had to make some arrangements to employ Dikte, such as wearing a Dikte microphone, checking the computer-projector connection, starting the program on the computer and navigating it during the experimental process. Some teachers pointed out to the difficulties they encountered as one teacher cited "I had to check if everything was working such as software [Dikte], projector and microphone. In the beginning, it took around 5 minutes to set up everything" (Teacher 14), while another one commented "My classroom needed to be redesigned for this study, because it is a traditional classroom, my students do not sit in a U shape [U is a seating plan where all of the students can see the teachers' face in the classroom]. So, for this study, I had to change the sitting position of the students each time" (Teacher 6).

A final challenge for implementing Dikte was the transition from a traditional classroom set up to an ICT-based environment. The teachers had to make some arrangements to employ Dikte, such as wearing a Dikte microphone, checking the computer-projector connection, starting the program on the computer and navigating it during the experimental process. Teacher 15 argued that "Guidelines for Dikte use were clear. However, they were difficult to remember for me. I made many mistakes and it took 2 weeks for me to properly dictate voice commands." Teacher 8 stated that "Voice commands

consisted of very specific words and sometimes I forgot how to make a new line or delete mistranslated words with voice commands; it took me some time to get used to these words." This problem was also observed during the observational sessions where some of the teachers printed out the voice commands to ease recalling, while others preferred to implement them from memory. In both cases, after a couple of practice activities, most of the teachers have demonstrated good user skills.

Theme 6. Efficiency of Dikte on Note Taking

This theme assesses the efficiency of Dikte on note taking in terms of minimising the time-spent for note taking and providing comprehensible classroom notes. The note taking skills of students with DHI were also analysed and reported. Overall, the data suggested positive views for the note-taking capacity of Dikte. The professionally taken lecture notes were particularly appreciated by both the teachers and the students. In addition, there were some varying views in relation to the reports on the note-taking skills of the students with DHI.

The data from interviews with teachers and students highlighted that Dikte has the capacity to considerably decrease the time needed for note taking. For instance, student 3 pointed out that "I was given Dikte hand-outs after some of the classes. This was very helpful because I was spending lots of time for note taking in lessons." In support of this view, student 8 reported "My teachers usually write everything on the board and we copy it [into our notebooks], and spend too much time. But now [referring to Dikte] we do not have to do that, the teachers provide us lecture notes." Similarly teachers reported that "It [Dikte] has decreased the time my students spend on writing down the covered topics into their notebooks." (Teacher 5) and "What I liked the most [about Dikte] is that it provides print-outs of what was covered in the class. This comforted me because we spend most of our classroom time waiting for the students to write down the sentences into their notebooks." (Teacher 2) and lastly "Some of my students copy the board letter by, and it kills lots of time. But with Dikte, we saved lots of time" (Teacher 15).

The teachers commented on the benefit of Dikte for transcribing the teachers' verbal information in written format, and demonstrating them on the board by a projector, which helped them to save a lot of time. The responses regarding this advantage included "With Dikte, I have just explained the topics and they were written on the board, so I did not have to write them on the board which saved lots of time. They [my words] were on the board in a few seconds" (Teacher 10), "It [Dikte] really decreased the amount of time that I spent on writing on the board by hand which took at least 5-10 minutes and I also needed to explain this simultaneously" (Teacher 1) and "Sometimes I need to write the stories of some topics on the board which is time consuming. Dikte is effective in this regard, and even within two months helped me a lot, because I told the stories into Dikte and got them written on the board" (Teacher 13).

Findings from interviews with teachers suggested that transcribing lectures into text format and forming classroom notes were valuable. The teachers mainly edited these notes at the end of the lessons to correct spelling errors, reorganise sentences or delete unnecessary information to provide professionally taken classroom notes for students. It is worthwhile to note that the teachers described the students' note-taking skills by using adjectives such as "unskilful." "meaningless," "non-sense," "useless," and "poorly-taken." The teachers argued that students with DHI were not usually good at both capturing exactly what happens in the classrooms and taking notes on the topics properly. The following interview reports support this view: One teacher stated "I should say that these students often miss lots of information during note taking. In this regard, I think Dikte was an effective and helpful tool to produce professional notes for them," (Teacher 2) while another teacher discussed "Now, when I look at the other classes in which I did not use Dikte, the notes taken by my students are very weak and are often missing a lot of information. So Dikte notes are important. They produce notes of exactly what is covered, and guarantee taking correct notes" (Teacher 13). It was also reported that "My students are quite bad at taking notes, I mean they sometimes cannot even read their own notes. I was able to provide accurate classroom notes for them [with Dikte]" (Teacher 15). Principal C explained this issue "I saw that with short training, we can create very professional texts [referring to Dikte-produced notes]. I really liked distributing edited classroom notes to the students at the end of each class. This is something that we have big difficulty in at this school: making students take good notes; most of them cannot even capture very basic information. So Dikte was very helpful in this matter." Another interviewee approached this issue from a different angle stating "Until the beginning of this semester [second semester], my students completed 3-4 notebooks covering notes taken in the lessons, what happened to these notebooks? I guess they put them somewhere and do not use them again, or rarely look at them. Because these notes are taken very unskilfully and do not mostly make sense" (Teacher 16). Lastly, principal A commented that "I know that our students' notes are taken very badly, I mean they are sometimes useless."

Observational findings provided important insights into the issues revolving around the note-taking skills of students with DHI and the benefits of Dikte transcriptions. To begin with, teachers told the researcher during the implementation of Dikte that the students' notes predominantly missed the most important information, which were not sufficient for improving either their comprehension or academic achievement. In light of its note-taking capacity, both the teachers and the students thought Dikte was helpful. Dikte hand-outs were often praised. For example, one student reported "I did not even think that the teacher has spoken that much [as opposed to the information provided by Dikte print outs]" while another said "if Dikte did not give us whole lecture notes, I would miss half the information." Additionally, after receiving Dikte print outs and studying them, one of the students stressed that "I am very happy to get Dikte notes, because it makes me relaxed; I just sit down and listen to my teachers in the class."

Theme 7. Dikte for Curriculum Development and Oral Language use

The use of Dikte materials in transcribed text and audio-recorded formats have been reported to be a possible venue for both curriculum development and enhanced oral language use. The findings suggested that the natural speech of the teachers provided a simple way for teaching that the students could comprehend relatively easier compared to textbooks. Additionally, often times the textbooks were found to be too advanced for the academic level of students. Dikte could compensate for this by providing an alternative route for teaching. Moreover, Dikte was also effective in encouraging oral language use in classrooms since it depended on transcription of verbal conversations. This is particularly important for schools where sign language is widely used, and oral language usage has been negatively affected by barriers such as hearing devices with low qualities, widespread sign language usage outwith school (e.g. home and school dormitories).

Dikte materials such as transcriptions and audio could be used for curriculum development. Teacher 3 commented "Dikte helped me to simplify some topics in the books. For example, I sometimes told the stories from the books in my own words and distributed Dikte-produced lecture notes to the students, because I think they were easier to comprehend." Similarly, teacher 12 reported "We have to simplify the textbooks, so rewrite or explain the stories in simple ways. Dikte was very helpful to allow us just to talk into a microphone and get everything written down." Moreover, the importance of storing Dikte materials was highlighted when teacher 10 discussed "I think, let's say if we used Dikte during a year, a lots of topics will be transcribed and sound recorded, so the teachings would be a great contribution to the curriculum development."

The need for a specifically designed curriculum meeting the academic needs of students with DHI was put forward by interviewees "For instance, in 7th grade, the readings from the books are extremely difficult for these students to understand. I know they do not understand most of the vocabulary and just pretend that they understand it. It is a pity for our education (Teacher 10), and "In our books, stories have been written for normal students' academic level; our students can hardly understand them" (Teacher 13). Principal A argued "Our students with DHI have to be considered as special, everyone agrees on that, however, when it comes to curriculum to educate them, we are forced to use the standardised curriculum same with everyone. Each year our school reports how our students are academically behind than their peers in general schools, and we clearly state this curriculum does not work for us, if it is working, why we [our students] have never academically reached what our education system's overall academic targets are". In addition, teacher 5 discussed "Just imagine a science class activity, let's say photosynthesis, our curriculum explains it clearly and we need to teach it in 5 lessons. We have just books to use and everything is written mostly in text format. Let's start teaching. First, most of the students will not know several vocabularies, you try to explain them in pictures and sign language as well. It takes time. Then the sentences are complex in grammar and could be very long. Second, there

are not pictures in the books that can make sense for students. I mostly find pictures and show in the class, just imagine that for each class I should do this. Anyway, there are hundreds of issues like this. But, why we are not provided with a curriculum specialised for these students' academic needs, so that we can teach much more better, I mean with more visuals, videos, games etc.". There were some other comments referring to the similar problems experienced with standardised curriculum and a need for a differentiated one for educating students with DHI.

Dikte was identified as an important asset for encouraging oral language use in classrooms. In addition to encouraging oral language due to Dikte's inherent requirements for speech transcription, Dikte may also be instrumental in discouraging sign language use. Sign language use has been reported to impede the creation of an environment where oral language is encouraged. The findings about the general support of Dikte for oral education suggested that "Dikte fits in with our school's main mission in relation to using an oral approach, since it is based on verbal conversation" (Teacher 4), and also "We have to first transfer information verbally by addressing hearing, so Dikte is directly about transcribing verbal conversations and can be an additional tool to help in this matter"(Teacher 7), and lastly "I think it is a good technological tool to support oral education because it works like that [referring to Dikte's requirement of oral language]"(Teacher 12). Barriers to using oral language were also highlighted. One interviewee stated: "In our school, we often have to use sign language, but we need something that encourages students and teachers to use an oral language approach. Our main necessity is to use oral language, which becomes more difficult since many of our students' families are hearing impaired, and they use sign language with each other. So, our biggest barrier I guess is teaching audibly. I mean educating students via oral language and developing their listening and speaking skills. We have to encourage these students with programmes like Dikte so that they can speak or understand sounds up to some level. Even if they do not speak, they may understand what they hear. Dikte in this respect has a very promising future" (Teacher 14). Another interviewee indicated "We always try to use oral language. I am specifically very strict about it, because I am a language teacher and have to be careful to maintain oral education in the school. Therefore, we need to improve oral approach in any sense. Dikte is a great tool to support it [oral language use] and it suits very well in this particular issue" (Teacher 8).

Interviewed teachers raised another problem which was about the lack of sign language training for the teachers during their undergraduate studies. This was due to the nationwide prohibition of the use of sign language in special education schools in the latest constitution (ÖGM, 2002). Because of this rule, the teachers are considered as those who will not need sign language and are not supposed use (legally prohibited). One main reason behind this rule was to encourage oral language use by preventing sign language use. Teacher 5 stated "As our school's mission statement says, we have to use oral language. We as teachers do not have to know sign language because we have not been taught it at the university because of the rule [referring ÖGM, 2002] for our schools. However, we use sign language because we sometimes have no other option; also, we have a dorm where almost half of our students stay, so they

mostly communicate in sign language with each other. I think it directly decreases the success of our school in encouraging oral language. Also students who stay with their families use sign language at home because a large number of their family members are hearing impaired" (Teacher 5). In addition, teacher 11 argued "I understand that this rule [ÖGM, 2002] tries to encourage oral language use in our schools, that's fine. But, everyone knows that teachers and students will use sign language anyway, so I think equipping teachers with sign language knowledge is necessary and will not encourage them to always use sign language in class. We can properly control oral and sign language, but not providing any sing language training is not a solution, rather it is turning a blind eye on this issue".

Theme 8. The Perceived Advantages of Dikte

This theme collectively involves views on the advantages of Dikte for students with DHI. Dikte enabled the students to test their hearing skills, improved their academic skills in comprehension, reading, listening, focus and studying.

Reportedly, Dikte helped create a link between transcription of the teacher's words and self-testing of student hearing skills. Since the transcriptions of the speeches in text format occurred simultaneously, Dikte provided an opportunity for students to assess their hearing skills by comparing what they heard with the live transcriptions on the board. In relation to this, student 2 commented that "My teacher's words were on the board word by word, I was trying to test my hearing and lip reading skills by looking at the board." Several teacher comments supported this. For example, teacher 10 stated that " I remember that students were checking whether they have heard correctly by sometimes reading my lips and looking at Dikte transcriptions on the board," and teacher 13 mentioned When my students saw the written format of what I said on the board, they began criticising themselves about whether they had heard things correctly, so they were able to check their hearing skills." Lastly Teacher 15 commented "they [the students] were watching the words appearing on the board and checking if they have heard right by comparing my words with Dikte transcriptions".

According to the observation notes, there were many occasions where the students were trying to test their hearing ability. After a couple of weeks of Dikte use and with their teachers' encouragement through prompted questions such as "please check [by looking at the board to Dikte transcriptions] if you can understand what I am going to say", or "can you please pay attention to the words appearing on the board as I speak?", students who had better hearing and speaking skills seemed to be more enthusiastic in testing their hearing skills.

Dikte was also effective in improving students' comprehension. Student 10 reported that Dikte hand-outs were easier to understand, saying "The hand outs with pictures were nice because I was able to understand them better. For example, in science class, the teacher gave us a hand out of human body parts, it was easier to understand than our textbook." Another student detailed an example of Dikte usage and how he understood the topic better by explaining "It was good like when my science teacher

said some specific words into microphone [Dikte], I was able to see them [written on the board] and understood better. I am not very familiar with scientific words like human bones or organs, I was able to see their pictures and words [written formats] together, I know I understood better like this" (Student 9). Student 4 reported "One of my teachers showed us a caricature program. He spoke and we saw the words [written] in boxes, it was fun and easy to understand [referring to conversations in caricature program]." Teacher 9 stated "after distributing Dikte documents mostly in text format, I told the students to study them at home. What I observed was that they understood the covered topics better." Similarly, teacher 10 reported "I think it (Dikte) has supported their [students'] comprehension skills because they were remembering pictures and related texts well after a couple of days."

Along the same lines, some of other comments were "I have to mention that my students demonstrated a good understanding of classroom topics" (Teacher 3) and "When they [the students] saw written texts of my speech, I could see from their faces that they were understanding well, because I have years of teaching experience and I know if they were learning or not" (Teacher 11). A different approach to improving the comprehension skills of students was highlighted by teacher 8 in the comment "If we use Dikte and FM system [together] any longer, the students will be able to hear and read speech over and over, and I think they may eventually develop better comprehension abilities." Teacher 5 has expressed similar views "My students were able to hear as much as they could, and see the written formats of the topics. I also showed the pictures of these topics. When I delivered my teaching in this way with Dikte, I figured out that the students' comprehension skills were strengthened. I may not be able to scientifically prove it, but I can see it when I look at the answers that they give to the questions in quizzes as well as their increased level of participation in the class".

The data from interviews with teachers and students suggested that Dikte materials in text and audio formats enabled the students to learn with the flexibility of time and location. Teacher 1 pointed out that "Our students need to repeat a lot; they may not well learn or understand the topics at first because of their hearing loss. I mean, in class they usually miss a lot of information, so they need to work more than their hearing peers. Dikte materials can be an extra support and help in this regard." The possibility of repeating learning topics has been emphasised by teachers 13 and 7 as well, who respectively stated "I really liked to give Dikte print outs. I have to say that it has to be an obligation to give written texts of what is covered in the classroom, because our students need to read and read again to understand the topics and vocabularies, it takes time for them", "I especially liked the concept of enabling the students to work by themselves at home [referring to Dikte materials] and study the topics covered in the classroom." Also, teacher 4 mentioned the support of Dikte sound files for studying topics: "Recording our voices are effective for producing classroom notes [in sound format]. Especially in science education the students may need to study the same topics over and over, so Dikte has supported this." Continuing with the student comments, two students suggested that "I could study from

Dikte print outs again if I did not understand topics" and "A couple of times I have listened the previous lesson recordings, … it was good to repeat the topics" (Student 6 and 7) (see figure H below).

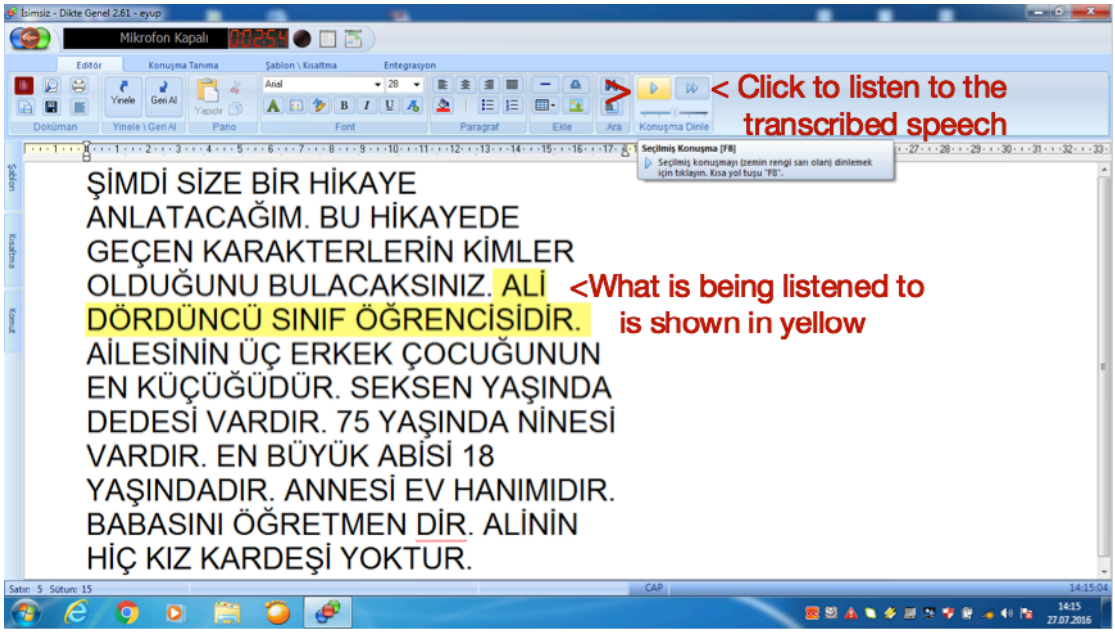

Figure H. Dikte feature listening back the recorded/transcribed speeches.

This figure shows how Dikte enabled students to listen back to the recorded/transcribed speeches. The yellow colour enabled students to track speech and transcript.

The data highlighted that Dikte sound files supported the listening skills of students in different circumstances which included listening to natural speech, and being more familiar with their teachers' individual accents, voices and pronunciation varieties. Principal B suggested that if the students listened to Dikte sound files, they would become familiar with their teachers' voices, while Principal C pointed out that Dikte notes had the potential to improve students' listening skills, because they could listen to their teachers' voices, accents and speaking/pronouncing styles. The importance of listening to natural speech has also been discussed as "students need to listen to natural speech regularly, because they need to learn basic communication and sentences, so Dikte sound recordings have supported that need" (Teacher 14). Teacher 10 also supported this view "Dikte sound files are important because our students have to practice listening and speaking exercises a lot. They have to, so they can practice sound files at home, or they can access to them anywhere".

In addition to the reported benefits, the ability to edit the text output of Dikte in different colours and characters as well as having live transcriptions of the speech encouraged the students to pay more attention to, and concentrate on the learning. As one of the interviewer emphasised: "When I was using Dikte, the students were paying more attention to what I was saying, … it [Dikte] has encouraged them to pay more attention to me" (Teacher 6). In the same respect, teacher 9 suggested that "I want to discuss the adjustable feature of Dikte texts, … I used different characters, colours, etc. So, they [the students] were paying more attention to the learning topics." Additionally, regarding the increased

concentration of students, the teachers reported that "When Dikte helped me to combine sound and texts, students' concentration skills were much better" (Teacher 2), "They [the students] were more focused on me and were better following the learning topics" (Teacher 15) "I can definitely say that their [the students'] concentration was improved" (Teacher 7).

Dikte transcriptions were reported to provide emotional relief to students as the students could simultaneously see the spoken words on board and obtain related printouts at the end of class, which saved them from the stress of taking detailed lecture notes. This was highlighted in the following student comments: "I was just listening to [the teacher], I did not have to take notes, so I was relaxed" (Student 7) and "I was given Dikte notes after the classes, it was very helpful, because I was spending lots of time for note taking and having difficulties on understanding. I was more relaxed [during the lecture] and just listened to the teacher" (Student 3). Moreover, interviewed teachers stated that "They [the students] were very relaxed, just sat down and receive teachings in print outs"(Teacher 10) and "My students told me several times that they were relieved when they saw [my words] on the board in text" (Teacher 13). And, lastly, teacher 7 explained that "I think the students were sometimes very relaxed because they were provided the written documents and sound files at the end of the class."

Dikte implementation in the classrooms created an interesting environment for learning, whereby the students were excited to experience novel software, much different from the overused traditional methods. Most interviewees emphasised that combining audio and visual teaching components excited the students. The following comments detail this: "It is a different strategy or technique. When my students first saw that my speech was being written on the board while I was lecturing, they got very excited" (Teacher 15), "I first showed a picture than explained the topics and Dikte wrote everything near the picture, the students were very excited to see such a program" (Teacher 10). Along the same lines, teacher 14 pointed out that "It was very good for them [the students] to be able to see what was spoken on the board in text, they got very excited at the beginning." Another teacher also stated "They [the students] showed great excitement when they were trying to hear my speech and saw them written on the board" (Teacher 3). Only one student reported excitement: "My teacher opened a Turkish map on the computer, talked into the microphone and city names were written (in text) on the map. We got quite excited" (Student 4).

Theme 9. Dikte Speech Training Module

The data regarding the potential capacity of Dikte for speech therapy suggest that Dikte could be used to train and improve the speaking skills of teachers. This is a special module in Dikte that was designed to develop the speaking/pronunciation skills of individuals. The main purpose of using this training module was to introduce it to the special education teachers, and to employ it with those who were interested in assessing their speaking abilities. The teachers also implemented this module with students with DHI on some occasions, where the teachers requested to use it with those whose students

with relatively advanced speaking skills. Using the findings of a couple of trials with their students, the teachers argued that Dikte could potentially be used to improve the speaking skills of students with DHI. Moreover, there were many comments that recommended using this program for students with DHI, especially for those with good speaking skills. However, some problems were encountered in this process, where the majority of the respondents pointed out issues such as difficult pronunciation of complex vocabulary and the need for redesigning this module or having another software adapted for students with DHI. The module, which contained a few hundred words most commonly used in Turkish, was designed to test the voice of the speakers' to identify mispronounced sounds. Each of the vocabulary was pronounced by tens of speech experts and recorded by the program designers. Therefore, the program recognises proper pronunciations of the vocabulary in the module and assesses/tests the speaker's speaking skills accordingly. In this module, there is a screen where vocabulary words show up and the speaker pronounces them one by one. When a pronunciation mistake is made, the program shows the mistakes with a red colour, and asks to the speaker to repeat the word. This discourages the user from skipping the mispronounced word and ensures that each word is properly pronounced. The module screen is shown below in figure I.

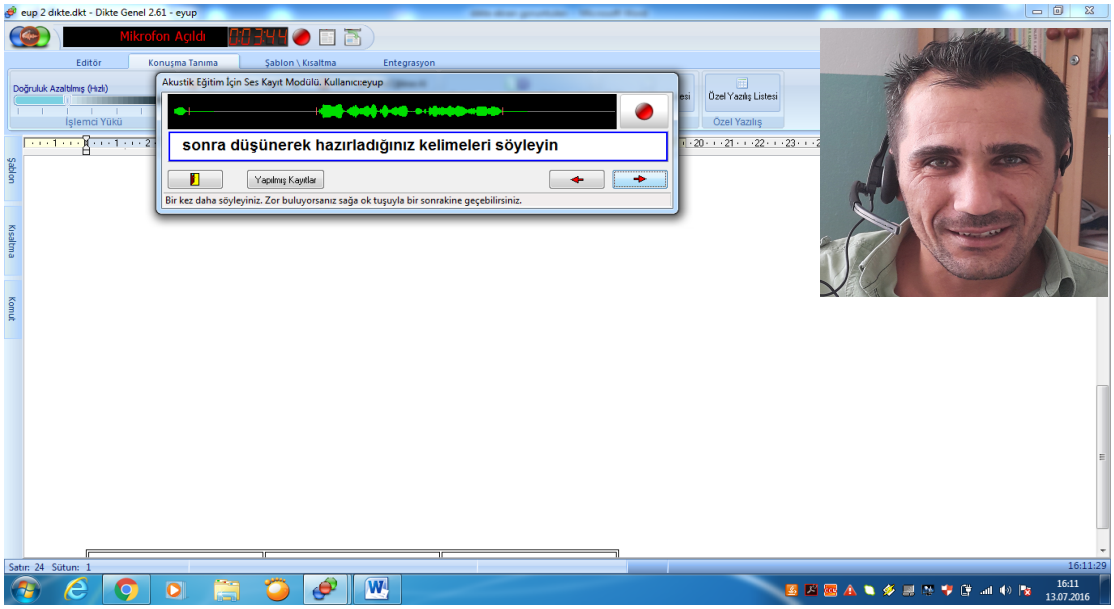

Figure I. Dikte Speech Training Module.

The interviewed teachers reported an increased feeling of responsibility for using clear pronunciation while using Dikte. In their view, Dikte encouraged them to pay more attention to their speaking skills. The following views were reported in respect to this: "When I used Dikte, I had to speak clearly, I think it is a good speech training tool in this respect" (Principal B), and "I should say that Dikte made me to control myself in speaking in the class" (Teacher 1). Teacher 8 also commented "While using Dikte, I felt more responsibility to speak clearer because I expected Dikte to transcribe everything that I said correctly, so I was quite careful about my pronunciation". Other comments were made by two

principals, who stated "I think, it is good to encourage our teachers to speak clearly" (Principal C) and "I believe it [Dikte] had a positive effect on the speaking skills of the teachers" (Principal A).

Summary

This chapter presented data collected from teachers, students and principals. Overall, the results were demonstrated under nine different themes. Interviews and questionnaire findings proved similar information about investigated topics however with some contrasting data (see table 17. pg. 124). Also, observations provided opportunities about validating the results of interview and questionnaire findings. It allowed the researcher to observe the behaviours and actions of students with DHI and teachers in natural fashion.

Hearing devices and FM system as a part of audio support material was considered to be crucial and successful for proper sound transferring to students with DHI, which in return enabled the teachers to teach verbally. Similarly, ICT materials were seen as being supportive in terms of visualising teaching through using pictures, cards, graphics, texts (written materials), charts, animations, vocabulary charts, cartoons, posters and computers. Besides, TV/Video, camera and sound recording tools were considered as old fashioned and the teachers and students with DHI reported quite few use of these materials for educational purposes.

ICT was perceived to be influential in developing the educational and academic capabilities of students with DHI, including visualisation through ICT, as being crucial to support the academic learning needs of students with DHI, since they are mostly visual learners. In terms of academic skills, different skills such as learning, writing, memorising, researching, and reading were mentioned in the interviews. In addition, the data showed positive views regarding how ICT usage increased students' social participation in classroom activities and motivation skills.

The data suggested an improvement in the technology and teaching skills as well as the quality of teaching skills of the teachers, a shift in the perception of the best methods for teaching students with DHI, and the increased reflexivity of teachers on both their teachings and required training for ICT use.

In analysing the facilitating and hearing factors for the use of ICT, only one topic as a supporting factor emerged. It was the technological proficiency of the young students that positively affected their skills. Barriers which decreased the use of ICT in education process were the lack of adequate support from the MONE of Turkey in relation to producing and distributing educational materials, the lack of quality of in-service teacher training which was reported to be mostly based on theoretical information, rather than providing practical teaching resources, knowledge and solutions to ICT issues. Teacher proficiency in ICT utilisation and knowledge was seen to be an important barrier in ICT use where the lack of ICT knowledge reported to end up with disappointment and ineffective ICT use. Similarly, spending extra time (sometimes excessive amounts of time) on the preparation of ICT-compatible lecture

materials discouraged teachers from applying ICT in the teaching process. Lastly, school administration support and the availability of budget issues were barriers, in that, teachers suggested that the use of ICT may not always be affordable in view of its fast changing nature and the high cost of educational software.

Examining the role of Dikte in material producing and storage suggested that Dikte materials (i.e. in text and audio formats) could be used to form a material pool that could then be shared by teachers and students. These documents were perceived to be natural, concise, clear and easy to comprehend as compared to other study materials such as textbooks.

Suggestions for future design of Dikte highlighted the need to redesign the Dikte speech training module by appropriately aligning it with the specific needs of students with DHI: for instance, being able to write very basic letters as they are pronounced. However, it was suggested that Dikte speech training module could be used by students with DHI who are good at speaking to develop better speaking and pronunciation skills, but not by those who are not.

The data reported the efficiency of Dikte on note-taking, whereby the time-spent on note taking and providing comprehensible classroom notes was seen to be minimised. Editing Dikte notes later was seen as supportive in enhancing the comprehension skills of students with DHI since they were highlighted, coloured, underlined, cleared from transcribing mistakes etc.

The use of Dikte materials in transcribed text and audio-recorded formats was reported to be a possible venue for curriculum development. The findings suggested that the natural speech of the teachers provided a simple way for teaching that the students could comprehend relatively easily, compared to textbooks. This is because, on many times, textbooks were found to be too advanced for the academic level of students with DHI, since deprivation of hearing decreases the academic skills in listening and speaking.

Moreover, Dikte use encouraged more oral language use in the classrooms, given Dikte's inherent requirement for speech transcription. This was seen as particularly important for schools where sign language is widely used. In this respect, Dikte was seen helpful in discouraging sign language use and in the creation of an environment where oral language is encouraged.

Furthermore, Dikte sound files supported the listening skills of students in different circumstances, including listening to natural speech, and being more familiar with their teachers' individual accents, voices and pronunciation varieties.

Dikte speech-training module was perceived to be useful in developing better speaking and pronunciation skills for teachers. The teachers had the opportunity to assess their pronunciation skills, reporting an increased feeling of responsibility for using clear pronunciation while using Dikte.

CHAPTER 5. DISCUSSION

This study has sought to investigate the perspectives of teachers, principals and students with DHI on the nature and usefulness of ICT in a Turkish special education school to support pedagogy and promote communication for students with DHI. This study has examined new ways of teaching and learning by creating an enhanced communication environment through the application of SR program called "Dikte".

This chapter describes how the research questions were addressed through the overall findings including 1) What are the views of special education teachers', principals and students with DHI on the usefulness and effectiveness of ICT, Dikte in particular? 2) What are the implications of using ICT for pedagogy, curriculum, teacher training, teaching and learning in pupils with hearing impairment? 3) What are the facilitative and hindering factors in integrating ICT in teaching pupils with hearing impairment?

The findings from RQ's showed some overlaps with the literature (see table 16) and also provided new findings and contributed to knowledge in some important ways. Explanations and suggestions were offered accordingly with existing literatures that were complementary and contradictory to each other.

This chapter begins with discussing overlapping findings of this study with literature along with identifying consistent and inconsistent data from interviews, questionnaire and observation. It continues with discussion of the new findings of this study.

Research Question 1.

The findings of this study demonstrated considerable overlap with the existing literature (see table 16, pg. 123) and added to knowledge in some important ways. The first finding regarding research question (RQ) 1 included audio logical support of hearing devices (especially FM system) as a part of ICT in terms of providing better hearing features (ex. clear sound signals, eliminating background noise and reverberation) and enabling teachers flexibility in movement. It was no surprise that the use of FM system was useful in encouraging educators to mainstream students with DHI more easily into general education since it provides better hearing in a noisy classroom environment. This finding largely overlapped with the related literature (Jacob et al., 2014; Lewis et al., 2004; Reynolds et al., 2016) (see table 16 below, pg. 123). However, caution must be applied that the technical quality of FM systems in transferring sound signals is the key factor in supporting hearing, with the low quality, hearing may be distorted (Reynolds et al., 2016).

Use of ICT was found to be effective in visualising learning by using videos, pictures, graphics, charts, maps, posters, flashcards, computers etc. This was seen as an important support of ICT in

developing better teaching strategies for teachers and addressing the specific visual learning needs of students with DHI since they are mostly visual learners (Marschark et al., 2013). All the data gathered from questionnaire, interviews and observations were complementary to each other regarding this issue, and showed some overlaps with the related literature (Zaharudin, 2011a; Pham, 2007; Gentry et al., 2004).

The findings from triangulated data noted that Dikte provided some practical and cognitive advantages for teachers and students. The main practical advantage was about enabling teachers to convey audio-visual lessons simultaneously, a process known as intermodal synchrony. Intermodal synchrony stimulates both hearing and seeing senses as a mode of information transport. From the teachers' viewpoint, combining audio and visual lessons provided practical advantages to deliver lessons in an effective way. This way of combining audio-visual lessons were noted as stimulating multiple senses, which could generate better learning outcomes (Bishop & Miller, 2009). Several studies have found that spoken language acquisition in individuals with DHI was higher in audio-visual teaching tests compared to audio only and visual only tests (Geers, Brenner & Davidson, 2003; Lachs, Pisoni & Kirk, 2001; Conrey & Pisoni, 2006; Desai, Stickney & Zeng, 2008), as audio-visual teaching utilises complementary information about speech segments which improve speech recognition (Navarra et al., 2005; Jesse & Massaro, 2010). In other words, each object has audio and visual qualities that are recognised separately by the brain and the cortical responses to audio and visual stimulus are different. When information is presented with audio and visual components together, two brain neural network areas of audio and visual recognition become simultaneously active and record the information accordingly. This way of recording information has been proven to be more effective than audio only or visual only in terms of speech and sentence recognition and memory (Grant, Wassenhove & Poeppel, 2004; Hay- McCutcheon, Pisoni & Hunt, 2009; Baskent & Bazo, 2011).

However, certain factors can affect the success of audio-visual asynchrony. Specifically, malfunctions of hearing devices such as delays of signal processing or asynchrony between audio and visual cues in communication materials may negatively affect students with DHI (Liu & Sato, 2009). In addition, the degree of hearing loss is likely to affect the success of audio-visual asynchrony. Compared to the students with profound hearing loss, students with moderate to severe hearing loss benefitted more from audio-visual asynchrony (Baskent & Bazo, 2011). However, we have to be cautious about this since the reported difference was based on the general assumption that students with moderate hearing loss can make better use of hearing skills compared to the students with profound hearing loss. Caution must be applied, specifically since students with profound hearing loss were found to make better use of residual hearing skills compared to students with moderate and severe hearing loss in a study with a very small sample size (Liu & Sato, 2009). Matthews et al. (2002) suggested that providing audio-visual teaching could be particularly useful in noisy classrooms where the audio signals tend to degrade. The current study did not attempt to assess the quality of audio-visual teachings

provided by Dikte in a scientific way. Therefore, these findings need to be interpreted in this context.

The note taking support by Dikte was also important in a sense that the interviewees in this study suggested the note-taking of students with DHI as "unskilful, meaningless, non-sense, and useless". These harsh descriptions could be attributed to the fact that taking (accurate) notes and listening to the teachers at the same time is arduous for students with DHI. This is consistent with existing studies which indicated that accuracy and comprehensiveness of classroom notes tend to be compromised often resulting problems for students with DHI (Wald & Bain, 2008; Shadiev, 2013). According to Wald (2010) and Zhili et al. (2010), poor note-taking makes no sense for students with DHI and hence it is a detriment to their learning. During lessons, it is reasonable to miss information, since impaired hearing ultimately affects note-taking skills. Strelnikov et al. (2009) highlighted that how well students with DHI can understand sign language or use lip-reading skills to understand speech directly affects their note-taking skills. One of the students in this study commented "I did not even think that she (the teacher) spoke that much" (student 10) to demonstrate that it is not surprising to miss a relatively high amount of speech input for students with DHI during lessons. In contrast, Wald (2011) and Shadiev (2013) found that recording all lectures with SR might adversely impact the note-taking skills of the students, and some of them may even misuse this chance to skip classes or copy and paste information given in notes in homework.

Meanwhile, in interviews and observation findings, it was reported that Dikte was favoured in encouraging oral language use in the classroom. From the teachers' viewpoint, it was difficult to find ICT devices, which directly encourage oral language use under the classroom conditions where sign language is extensively used. Such a support by Dikte could serve as a distinctive feature in the Turkish context. This kind of support by SR has also been cited in the literature in other languages, but remains quite limited (if any) in Turkish context (Shadiew, 2013; Leitch, 2008; Wald, 2012; Zhili et al., 2011).

Research Question 2.

The findings regarding RQ2 included implications of using ICT for pedagogy, curriculum, teaching, teacher training and learning in pupils with hearing impairment. They were discussed accordingly with the literature.

In terms of the pedagogical implications of ICT, this study reported similar findings to those literature (Lewis et al., 2004; Flexer, 2005; Desloge, Rabinowitz & Zurek, 1996; Reynolds et al., 2016; Edwards, 2002) by reporting that engaging with technology helped the teachers to reflect on their own teaching skills such as operating different ICT tools and employing them in classroom activities. However, a contrasting data (as table 17 shows below pg. 124) was identified in the questionnaire compared to the interview findings, where some teachers (%20) indicated that they had no idea (neutral)

if ICT improved the effectiveness of their teachings and %30 were also neutral if they were aware of the advantages of ICT in teaching.

The interviewees reported that ICT had the potential to modify traditional teaching models and pedagogical beliefs, as also cited in the literature (Riel & Becker, 2000; Chigona et al., 2010; Valiente, 2010; Wegerif & Dawes, 2011; Rekkedal, 2013). All the data collected from questionnaire, interviews and observations supported each other without differentiation regarding this issue. However, caution must be applied, in that the general view pointed out by interviewees was that ICT has the potential in this matter, but not a complete solution, and pedagogical changes occur slowly by taking advantage of ICT.

From the interviewers' viewpoint, ICT was seen as effective in changing teacher-centred instruction into student-centred ones. The general view was that in the traditional model, students are often considered as passive learners (memorising facts and reproducing data) while in the ICT integrated model, they are more active and productive learners by using their abilities in educative activities to construct mental representation of meaning, as also reported by research (Eurydice, 2011; Smith, 2011; Brill & Galloway, 2007; Anderson, 2010). However, this change has been considered as slow, but continuous by the interviewees, because not all teachers agreed that ICT was highly successful in changing traditional teaching models; rather it was perceived as contributory in this respect.

As a practical advantage of ICT for teaching, it was seen as supportive in decreasing the time spend on material preparation for teachers. However, inconsistent data in interviews was found that not all teachers have good ICT skills, so this can also negatively affect time spend on preparing teaching materials, which was also cited in the literature with similar findings (Goktalay & Ozeke, 2015; Lim & Khine, 2006; Harfitt, 2015).

The use of the general education curriculum for students with DHI was strongly criticised by the interviewees. All the data from interviews and observations complementarily argued that the current general curriculum was not working properly because its demands often exceed the academic level of students with DHI, since their academic skills were negatively affected by hearing loss (especially in listening and speaking). From the interviewees' viewpoint in this study, addressing this issue could be supported by modifying the academic achievement standards of the current (standardised) curriculum as referred 'differentiated' curriculum. Likewise, Antia (2009), Easterbrooks and Alwarez (2013) and Wheeler (2011) argued that in taking account of the academic achievement reports of students with DHI, they are behind than their peers (hearing) in many of the academic areas; therefore, it is an undeniable issue to be carefully considered by education authorities to provide solutions, whether in the name of differentiated curriculum or the modified general curriculum.

This study adds to the existing controversy around banning the use of TSL in Turkish special education schools and the problems emerging from this decision. The results of this study revealed that disapproving the use of TSL in Turkish special education schools is tantamount to ignoring its

widespread use and impairing its quality, as confirmed by the literature (Arik, 2015; Kemaloglu & Kemaloglu, 2011). A theoretical case for this in the literature is that TSL was banned to encourage oral language use (Ozyurek et al., 2004). It is however, specifically indicated by the interviewees in this study, since in view of the lack of proper TSL training/knowledge and banning it, TSL has not been properly developed as a working language to teach complex linguistic preferences of TL which inevitably decrease the quality of teachings that the Turkish special education teachers provide. Some alternative solutions were offered by the interviewees, officially acknowledging TSL use along with oral language and providing proper TSL trainings for teachers and students. Related studies have also suggested the same strategy, namely integrating TSL and oral language in the education process of students with DHI in Turkey (Arik, 2015; Zeshan, 2003; Ozyurek et al., 2004).

Visualising teaching materials through ICT was found to be crucial in developing the comprehension skills of students with DHI. The use of computers to provide visual materials such as showing pictures, short videos or clips, graphics, charts, posters, maps, flashcards, and tables of the learning subjects was regarded to be important for improving the comprehension skills for students with DHI. Most students with DHI are believed to be "visual learners" (due to their reliance on vision for language [sign language or speech reading]); therefore, using any device that helps visualise learning subjects would be of some value (Marschark et al., 2013). Interviewed teachers and students in this study along with questionnaire findings (20% strongly agree and 80% agree) reported that visuals support comprehension by providing various channels of information transfer. Similarly, Easterbrooks and Stoner (2006), Li (2007), and Kearly, Pivec, (2007) and Zaharudin (2011a) argued that visualising teachings through ICT was helpful for establishing links between an idea and the students' imagination, enabling comprehension of the principles of the learning subjects, and exploring different ways of understanding learning topics. Existing research recognises the critical role played by visual modality which "may facilitate the perception of the word's auditory counterpart in communicative situations" (Strelnikov et al., 2013). This is particularly important development, because this relationship enhances cross-modal plasticity and fosters speech-comprehension recovery in individuals with DHI. However, investigating any information related to this relationship was out of the scope of this study.

ICT was seen as supportive in enhancing vocabulary learning skills of students with DHI by providing various educational materials that demonstrate vocabularies in several formats (picture, sign language, audio etc.). The triangulated data from questionnaire, interviews and observations complementarily highlighted the importance of ICT in enhancing vocabulary learning skills of students with DHI, similar to other studies (Tautkeviciene & Bulotaite, 2009; Wheeler, 2011; Nezhat, Atarodi & Khalili, 2013). These studies mainly noted that ICT tools provide important vocabulary development opportunities, essential in reading, writing, comprehending the subjects and communicating, through providing different channels of learning (audio, visual).

ICT was perceived to support students' social participation and motivation in classroom activities as cited in a large body of literature (Bossaert et al., 2013; Pham, 2007; Söderström, 2014; Hashim et al., 2013; Popovici & Beciu, 2011). This study largely found similar findings that the students were encouraged to engage with each other through activities such as working together on computer-based learning activities, in-group studies related to ICT, learning from animation programmes, and challenging each other in computer based learning activities. Also, the use of ICT was noted to increase the motivation of students with DHI by capturing their attention on classroom topics, which mostly sustained motivational stimulus. However, contrasting data emerged where some of the findings from observations did not quite match with the interview findings. For instance, interviews reported that students became highly motivated when new ICT tools were implemented in classroom activities; however, in some of the observations, students did not show any interest or motivation to some forms of ICT use (e.g. online mathematics games). Hence, generalisation in regards to ICT's positive impact on this matter is not supported by this study; rather, it suggests some benefits. Similarly, Nordin et al. (2013) showed that not all ICT resources are motivational in that some of ICT tools may demotivate students with DHI if their specific needs and requirements (e.g., clear sound, simple visuals, relevant academic level) are ignored. Therefore, ICT use for motivational purposes cannot be generalised to diverse groups of people (Garberoglio, Dickson, Cawthon & Bond, 2015).

Research Question 3.

The findings from the triangulated data sets revealed facilitative and hindering factors of ICT use. Most of the findings indicated the commonest hindering factors along with only one facilitative factor.

The only facilitative factor of ICT was found to be being 'digital natives' for especially younger generations who were born into technology and have grown up with it. From the teachers' viewpoint, younger students are relatively good at adapting at technology use compared to the older students. The main reason, as pointed out in the interviews, was the more interaction and time spent on technology, which was seen as an important determinant for better technology skills. This finding overlapped with the literature where they indicated that ICT is being used more widely in classes compared to anytime before in the history, which enables younger generation to interact more with ICT and master related skills (Ihmeideh, 2009; Isciturk, 2012).

The first hindering factor was teachers' proficiency in ICT utilisation and knowledge, which was seen as an important positive or negative indicator of ICT use in teachings. From the teachers' viewpoint, due to the fast-paced technological developments, teachers may not cope with becoming proficient in using ICT and preparing materials in a timely manner. Questionnaire findings supported this view that the majority of the teachers (30% strongly agree, 65% agree) agreed that teachers lacked adequate knowledge on technology usage. This finding was mainly overlapped with the literature (Ihmeideh, 2009;

Oye et al., 2011; Kreijns, Acker, Vermeulen & Buuren, 2013; Hutchison & Reinking, 2011; Onder, Celik & Silay, 2011; Isciturk, 2012; Lopez, 2010; Teo & Noyes, 2011).

The lack of the quality of in-service teacher training on ICT was considered to be a hindering factor in ICT use. The evidence from the interviewees' viewpoint indicated that in-service teacher training should focus on supporting teachers to acquire practical and pedagogical skills rather than introducing very basics of ICT materials and largely theoretical information. A small proportion of teachers was not sure of (10%) or did not prefer (20%) to attend in-service training. This may be due to the views of teachers on these training sessions as not being very useful. These sessions were considered to be poorly planned or ineffective for professional development by the interviewees. In parallel, several studies suggested that in-service teacher ICT training programmes are behind the expected or planned level in relation to fostering designing skills, understanding the pedagogy of ICT and developing problem solving skills. These studies also argued that ICT training should target more practical skills rather than offering excessive theoretical information, especially considering the burden for ICT implementation is on teachers (Voogt et al., 2013a; Wachire & Keengwe, 2011; Goktas et al., 2008a, 2009; Birinci, Konur, Sezen & Tekbiyik, 2010; Yildirim, 2007; Tsai & Chai, 2012). This means that teachers are largely left alone to implement ICT use without proper training on the pedagogical and practical aspects of ICT. This may result in unprofessional ICT applications and dissatisfaction among teachers. Also, teachers' encouragement and expectation on the use of the ICT could be diminished if in-service teacher training is not forthcoming or relevant.

The lack of specifically produced ICT materials in Turkish Language (TL) was expressed as a hindering factor by the interviewees in this study. The number of such available ICT was inadequate and an urgent need for developments in this respect was encouraged by the teachers. Likewise, Aydin (2013), Sari (2013), Cuhadar and Yucel (2010) and Topkaya (2010) highlighted the lack of proper ICT resources such as computer software programmes and educative materials specifically in TL. Importantly, idiosyncrasies of TL including linguistic structure and grammar was seen as challenging which made it difficult to produce ICT materials that address TL linguistic components. A possible explanation for this may depend on the fact that TL is an agglutinative language with a remarkably high productive inflectional and derivational morphology. This finding overlapped with what were reported by Goksel and Kerslake (2005), Oztaner (1996), Yuret and Ture (2006), Arik (2009) and Arik (2010). Considering morphological structure of TL, Kubus (2008) discussed that it was even more difficult for students with DHI to comprehend TL since its highly derivational morphological features. It was strongly emphasised by the interviewees in this study and in the literature that there is a need for specifically developed ICT systems in TL by accommodating its range of linguistic particularities.

Limitation of ICT infrastructure and financial constrains were seen as one of the determinants of ICT uptake in the school which was also similar to those cited in the literature (Anttila et al., 2012; Brodin, 2010; Goker, Ozaydin & Tekedere, 2015). Brodin (2010) reported that the quality of the ICT materials purchased by schools depends on the available budget, and this is likely to impact on the quality of ICT resources available in class. The evidence from interviews and questionnaire findings suggested that the ICT infrastructure problems mostly depend on providing educational software, computer based teaching and learning materials, rather than utilising basics of technology including computers, printers, projectors, scanners etc. The questionnaire findings has also revealed that the teachers largely agreed that the lack of basic technology infrastructure of the schools including computers, scanners, printers etc. are not the main problems today, however, the real problem relies on the quality of ICT materials such as educative software and computer-based teaching and learning activities.

The findings from this study revealed the limited support from MONE in relation to providing ICT materials for teachers, highlighting the need for an institutionalised approach for the implementation of ICT in schools. As the findings in this study suggested, uptake of ICT varies, and often ICT is implemented through teachers' own initiatives without an institutionalised framework and material support. And this may eventually create confusion and demoralisation among educators. One informant reported that "We as teachers create our own materials, there is no material support or help from the MONE regarding this, and everything depends on the teachers' skills and choices. Of course this is not a good thing, each teacher might do different activities, even sometimes principals and other teachers do not know what the other teachers are using in the classrooms. I wish the MONE provided ICT materials for us" (Teacher 10). Consistently, Walsh and Light (2003) and Smith (2011) explained that professional guidance in ICT use may practically overcome concerns over the validity and reliability (standardisation) of ICT resources that teachers employ in classroom practices. Not all teachers are knowledgeable enough to assess and evaluate the validity and reliability of the ICT teaching materials. Therefore, an institutionalised approach could be a supportive factor to help the teachers to receive necessary ICT materials in a more controlled environment. MONE should collaborate with schools and be involved in mediating ICT change process, because it is the role of the state to provide educational reforms via the use of ICT. The reforms should be the result of consultations between experts in ICT intervention provided by MONE and school teachers. Considering the widespread use of ICT tools in today's schools and among people in this digital age, MONE needs clear pedagogical aims and frameworks to stimulate effective educational reforms.

Overlapping findings of this study with the literature	Related studies cited in the literature
• Facilitative effects of FM system	• Jacob et al., (2014); Lewis et al., (2004); Flexer (2005); Desloge, Rabinowitz & Zurek (1996); Reynolds et al., (2016); Edwards (2002).
• ICT found to be effective in visualising learning and enhancing vocabulary learning	• Marschark et al., (2013); Li (2007); Kearly & Pivec (2007); Zaharudin (2011a); Pham (2007); Wheeler (2011); Nezhat, Atarodi & Khalili (2013); Gentry et al., (2004).
• ICT perceived to support students' social participation and motivation in classroom activities.	• Bossaert et al., (2013); Söderström (2014); Hashim et al., (2013); Popovici & Belciu (2011); Akamatsu & Farrelly (2006); Nordin et al., (2013).
• ICT helped teachers to reflect on their own teaching skills.	• Schunk & Pajares (2004); Brown & Paatsch (2010); Albertini et al. (2012); Saiti & Prokopiadou (2009); Sun et al., (2010).
• Potential of ICT to modify traditional teaching models, and support student-centred instruction, albeit the progress is slow.	• Papaionnaou & Charalambous (2011); Lepi (2012); Riel & Becker (2000); Chigona et al., (2010); Valiente (2010); Bacigalupo & Cachia (2011); Rekkedal (2013).
• ICT found to be successful in changing teacher-centred into student-centred instruction.	• Eurydice (2011); Balanskat, Blamire & Kefala (2006); Smith (2011); Hew & Brush (2007); Brill & Galloway (2007); Anderson (2010).
• Facilitating ICT factor (being digital natives)	• Ihmeideh (2009); Isciturk (2012).
• Lack of ICT knowledge and pedagogical understanding of teachers.	• Oye et al., (2011); Kreijns, Acker, Vermeulen & Buuren (2013); Hutchison & Reinking (2011); Onder, Celik & Silay (2011); Saez Lopez (2010); Teo & Noyes (2011); Pierce & Ball (2009); Prestridge (2007); Keys (2007).
• Lack of ICT support from Ministry of National Education of Turkey (MONE).	• Orlando (2009); Loveless, Burton & Turvey (2006); Basturk (2005), Aydin& Gu̇rol (2016); Akbulut (2010); Aydin, Gu̇clu̇ & Pisapia (2015); Cakiroglu, (2015); Demiraslan & Usluel (2008); Goktas, Yildirim & Yildirim (2009); Sari (2013); Karal (2015).
• Lack of quality in in-service teacher training.	• Voogt et al., (2013a); Wachire & Keengwe (2011); Goktas et al. (2008a, 2009); Birinci-Konur, Sezen & Tekbiyik (2010); Yildirim (2007); Tsai & Chai (2012).
• Idiosyncrasies of Turkish Language	• Goksel & Kerslake (2005); Oztaner (1996);Yuret & Ture (2006); Arik (2009); Arik (2010).
• ICT budget concerns.	• Anttila et al. (2012); Goker, Ozaydin & Tekedere (2015).
• Issue surrounding the use of the general curriculum, with its demands often exceeding the academic level of students with DHI; need for a differentiated curriculum.	• Antia (2009); Moores (2000); Easterbrooks & Alvarez (2013); Garberoglio, Cawthon & Bond (2013); Schick, Williams & Kupermintz (2006); Wald (2012); Shadiew (2013).
• ICT-SR support in decreasing the time spent on material preparation	• Wald & Bain (2007); Zhili et al. (2010); Bingimlas (2009); Lowther, Strahl, Inan & Ross (2008); Lim & Khine (2006); Harfitt (2015).
• Dikte note-taking support	• Loveless (2011); Wald & Bain (2007); Wald (2010); Wald (2011); Zhili et al. (2010); Strelnikov et al. (2009); Shadiew (2013).
• Dikte transcribing accuracy	• Wald (2010, 2012); Wald & Bain (2008); Leitch (2008); Shadiew (2013); Zhili et al. (2010).
• Dikte –SR enabling teachers to convey teachings in audio-visual way	• Bishop & Miller, 2009). Geers, Banner & Davidson, 2003; Lachs, Pisoni & Kirk, 2001; Conrey & Pisoni, 2006; Navarra, et al. 2005

Table 16. Overlapping findings of this study with literature

In analysing the data from interviews, questionnaire and observations, some inconsistent data were identified. These inconsistencies were explained in the table 17 below.

Inconsistent Data	Interviews	Questionnaire	Observations
ICT effectiveness on motivation skills of students with DHI in classroom activities.	Students became highly motivated when new ICT tools were implemented in classroom activities	10% of teachers were neutral in this respect.	Students did not show any interest or motivation in ICT use (ex. online mathematic game).
Effectiveness of ICT in improving teaching skills of teachers.	Teachers mostly reported how ICT improves their teaching skills in positive ways; almost no negative reporting.	Some teachers (20%) indicated that they had no idea (neutral) if ICT improved the effectiveness of their teachings, and 30% remained neutral even if they were aware of the advantages of ICT in improving teaching skills.	
Effectiveness of ICT in decreasing and/or increasing time spent on material preparation	Inconsistency between the teachers' views.		Teachers demonstrated different perceptions.
Dikte transcribing accuracy	Most teachers saw Dikte as successful; however, some teachers pointed the amount of transcribing errors, especially in long speeches.		The behaviours of teachers highlighted that some teachers did not find Dikte successful in some circumstances, especially in mathematic and science classes.
Editing Dikte texts	Some teachers reported that the editing process was time consuming and difficult, while others did not regard it as a major problem.		Different behaviours were observed with some teachers having had difficulties in editing, and demonstrating tiredness.
Dikte speech training module	A small number of teachers pointed out that this module may be used for students with DHI, while the majority of others found it to be ineffective.		Many different behaviours were observed, with students with good oral skills being likely to benefit from this module, but majority of the teachers not finding it useful.

Table 17. Inconsistent data identified in interviews, questionnaire and observations.

Summary

There is evidence to suggest that ICT, Dikte and SR programmes may offer many advantages in teaching and learning, so long as they are used appropriately. The findings of this study and the related literature highlighted insights that ICT and Dikte are effective in developing comprehension skills of the students with DHI, promoting communicational access in the classroom (text transcriptions and sound files), supporting curriculum development, and facilitating pedagogical interventions.

CHAPTER 6. CONCLUSION

6.0 Introduction

This study set out to investigate how ICT is used in a special education school to support pedagogy and to promote curricular and communicational access for students with DHI. Uniquely, this study examined a specific Turkish speech recognition program called Dikte through employing it in a selected sample of Turkish classrooms in one school, which aimed to unpick the different ways it may enhance teaching and learning for students with DHI. In doing so, the research questions outlined in the introductory chapter have been addressed.

6.1 Key Findings

This study adds to knowledge in some significant ways regarding the findings based on RQ's and the following conclusions have been drawn. Two meta-developments (see table 18 below) contributed to knowledge, as the first one is about Dikte effectiveness in material producing and in meeting the digital material demand of the school, in helping to enhance teachers' material producing capabilities and professionalism in teaching, supporting pedagogy, curriculum and promoting communication access, and enhancing comprehension skills of students with DHI. The second one is the need for institutionalised MONE support and demand for a top-down approach, the lack of ICT materials supported by MONE and its consequences as forcing the schools to outsource ICT.

Contribution to knowledge by the key findings of this study
1. FIRST META-DEVELOPMENT
• Dikte supports digital material demands of schools and helps to enhance teachers' material producing capabilities and professionalism in teaching. • Dikte supports pedagogy and curriculum and promotes communication access. • Dikte develops students' comprehension skills.
2. SECOND META-DEVELOPMENT
• Top-down approach, despite its undesirable status in the literature, may indeed be advantageous in Turkish special schools where teachers are not excluded from having an input. • Turkish special education schools outsource ICT services from outside companies because of the lack of MONE support in this respect.

Table 18. Contribution to knowledge by the key findings of this study.

6.1.0 First Meta-Development and Implication for Theory, Policy, Practice and Pedagogy.

Firstly, to the best of my knowledge, this is the first study to examine the use of a SR device (Dikte) in students with DHI in Turkey. This study has uncovered new knowledge about SR use in Turkish language and Turkish schools for students with DHI. Therefore, the results of this study could be an important scientific resource for theory and policy to act further upon SR use in Turkish context.

This study has found that Dikte produced materials in written and audio recording formats were supportive in meeting the digital material demand of the school. The teachers regarded Dikte as helpful in producing materials and sharing them with other colleagues and schools since they were in digital formats. Practically, this creates an interaction between teachers, students and other schools, which in return would educationally benefit more people. Digital materials produced by Dikte can be used to learn from each other for teachers, which supports their pedagogical understandings of subjects. It emerged, however, that Dikte sometimes compelled teachers to produce materials in written format, since it required editing. This is an inevitable issue reported in other studies where SR tools were found to be challenging, especially in editing long speeches (Shadiew, 2013; Wald, 2012; Zhili et al., 2011).

Dikte was supportive in enhancing teachers' material producing capabilities. This implies that it encouraged teachers to expect more from ICT and improve self-confidence in using it in actual classroom settings. However, it should not be ignored that the positive data were mainly reported by those who identified themselves as good at ICT use in the interviews, and this sometimes ended up with negative results for others with relatively low ICT skills. This approach was mostly pragmatic considering the pros and cons of ICT use. From the teachers' viewpoint, ICT use may potentially take time to master and sometimes put them under pressure to change the way that they normally work in classrooms. Zhili et al. (2011) and Shadiew (2013) reported that teachers' ICT competences were one of the main indicators for positive or negative results in producing materials with SR software. In addition, using Dikte is likely to provide pedagogical developments where teachers advance their material producing skills by creating materials based on their own expertise. It ultimately increases their reflections on teaching skills as well.

Creating a material pool with produced materials by Dikte was seen a significant contribution for teachers' professionalism. Some teachers felt more prepared and ready to teach by taking advantage of the material pool created from Dikte documents. Using Dikte for such a purpose would create significant interaction between teachers whereby they can professionally evaluate, analyse, adopt and exercise each other's produced teaching materials and could be pedagogically more equipped to teach. Also, this helps to develop teachers' pedagogical content knowledge where they can develop multiple strategies to teach the same topic and accordingly better understand the misconceptions that students with DHI are likely to have. This further implies the psychological effects of having such a material pool ready for teachers who have the potential to increase the readiness, preparedness and satisfaction in teaching. Hence, policy

makers may consider such a support by Dikte to decrease retention issues of special education teachers' causing by the lack of such material pool. Related to this, Drent and Meelissen (2008) have found that being prepared for teaching in terms of availability of materials is a positive psychological contributor in satisfying teachers regarding their professionalism.

The findings of this study from interviews with teachers and students noted that Dikte supported students' cognitive skills. Several interviewees expressed that especially the classroom notes generated by Dikte helped the students to understand the lecture content better and improve learning achievements, especially when edited to correct mistranslated words and supported by extra teacher explanations such as highlighting or underlying sentences, synchronised with transcripts, images, bookmarks, links to videos of sign language translations. This finding partly overlapped with the literature investigated SR use in this respect (Elliot et al., 2002; Leitch et al., 2008; Wald & Bain, 2008; Wald, 2010; Zhili, Wanjie & Cheng, 2010). However, considering Turkish Language and context, this is the first study (if any), which reported this finding in the literature, hence provided new information. Therefore, this study could be a base for further studies in Turkish context to develop theoretical frameworks regarding SR application concerning cognitive skills developments. Theory-wise, Turkish MONE may consider integrating SR/Dikte use in teaching models to specifically address the cognitive developments of students with DHI by providing classroom notes. This approach may encourage the development of better teaching practices, where teachers could make teaching directions more explicit and precise by using Dikte. In addition, being able to synchronise classroom notes with images, bookmarks and links to videos of sign language translations provide pedagogical advantages, where teachers enhance their understanding of transferring knowledge in more effective ways. Another implication of practice by Dikte materials for students with DHI is about expanding our understanding of the temporal and spatial dimensions of learning. Accessing learning in such a flexible way means that the students can learn wherever and whenever they need to.

Dikte was reported to be effective in promoting curricular access where Dikte made a noteworthy contribution to the simplification of the subjects taught in a natural, concise and clear way. This is especially important since the literature and data from interviewees in this study have shown that most educators suffer in providing access to the general curriculum for students with DHI and curriculum often exceeds the academic levels of students with DHI. It leads the concept that Dikte can practically supports teachers to differentiate curriculum through Dikte and pedagogically adjust or modify teachings in accordance with students' comprehension levels. Theoretically, the education system of Turkey considers students with DHI as capable of accessing the curriculum as much as their typical/hearing peers, however, in reality, in the lack of addressing their specific educational needs including visual learning in curriculum, the educational effectiveness of general curriculum inevitably decreases in providing equal access to curriculum for students with DHI. The theoretical approach behind this issue should be critically analysed and scientific studies should be conducted to explore the advantages and disadvantages of employing a standardised curriculum for everyone, without considering

unique human necessities of students with DHI. Hence, policy makers should seriously consider educational reforms in this respect.

Dikte was regarded as being useful in enabling teachers to convey teachings in an audio-visual way (known as intermodal synchrony) simultaneously. The significance of this is to empower students with DHI to be auditory learners and providing communication access skills. This conclusion is likely to create a momentum for rethinking the teaching methods used for these students, as the existing methods are mostly based on visual learning. This unearths the need for teachers to revise and develop their pedagogical knowledge in relation to the mode of transfer of knowledge in teachings. In addition, this means of information transfer helps to develop better communication access for students with DHI where they can compensate information missing from audio channels through reading text transcriptions. The significance of this is to increase the engagement of students with DHI in learning more actively, by reading the transcriptions while listening to the teachers. Another practical implication of Dikte for teachers would be that many of them struggle in transferring teaching and learning materials in audio and visual formats to benefit students with DHI. This implication for practice could further encourage educators to seriously consider Dikte/SR application in teaching and learning activities.

6.1.1 Second Meta-Development and Implication for Theory, Policy, Practice and Pedagogy.

A noteworthy finding indicated that Turkish special education teachers questioned the need for an institutionalized approach to supporting ICT in schools, with the need for MONE to develop a framework to support ICT pedagogy and offer the required resources. This top-down approach has been contested in the literature especially in democratic societies (Krogstrup, 2004), as it is based on governments providing educational reforms, pedagogy, and curriculum without involving schools, educators or students in the decision-making process. However, the findings of this study demonstrated that this approach, despite its undesirable status, may indeed be advantageous in Turkish special schools where teachers are not excluded from having an input. However, this raises bigger questions that require an appropriate conceptualization of the role of MONE in determining matters of pedagogy. The advantages of the bottom-up model for developing unique and creative educational strategies by schools, teachers and students may be undermined if the schools depend exclusively on MONE, without being offered opportunities for consultation, especially since so far MONE has failed to meet the EU requirements for ICT use in education (The Global Information Technology Report, 2015). Due to the unsatisfactory educational outcomes of a top-down approach by MONE, there is a pressing need for educational reforms that benefits from a bottom-up model, as this is shown to be more effective in the literature (Smith, 2011; Krogstrup, 2004). However, this finding is interesting because although the bottom-up model has become more appreciated and accepted in the literature, this finding may make an important contribution for policy makers to act further upon developing ICT interventions, showing the

value of a top-down approach in Turkish context.

The findings of this study revealed that since the lack of ICT materials and services supported by the MONE, the special education schools in Turkey are likely to attempt to bridge this gap by outsourcing ICT services from outside companies. The literature review offered two views: one suggesting that schools benefit from outsourcing (Powell, 2014), and the other raising concerns about the possible dangers of outsourcing (Burch, 2009). This study found no significant position in either of them; however it found that the Turkish school in this study had no choice but to outsource ICT to outside companies. Also, the problem is not just a technocratic issue about MONE providing ICT materials but also a pedagogical one, because even pedagogy could be (partly) outsourced by schools in the lack of professional MONE support. This leads educators to question the educational policy behind this in Turkey. Therefore, there is a need to reconceptualise Turkish education policy to utilize pedagogical and practical ICT use in Turkish special education schools, mainly supported by the state. Hence, a key policy priority should be to revise the education system and encourage more ICT generation and integration in the education process of students with DHI.

The final implication of this study is about using this thesis as a basis for creating a European Union (EU) project regarding ICT use in special education schools for students with DHI in Turkey. This EU project was funded (total budget 200.000 Euro between 2015-2016) and served to provide various ICT materials mainly for the school this study took place and other schools throughout the country and Europe. The provided ICT materials included FM systems, high quality hearing devices, establishing sound amplification systems in 2 classrooms, computer software, computer games, online educational activities, speech therapy materials and various visuals in digital formats which could be used in smart boards, sound recorders and more. The digital materials were shared freely with 44 schools in Turkey and 25 schools for students with DHI throughout Europe. For further information visit http://www.voiceofvoiceless.net/index.html .

6.2 Strength and Limitation of the Study

The findings of this study were limited in terms of the use of a small sample. The territory covered was a secondary school for students with DHI in Turkey. The external validity and reliability of findings could be enhanced by using greater sample sizes and a number of randomly selected schools. However, the scope of the study was not to generalize the results but to gain an in depth understanding of the processes involved in using ICT to support teaching and learning in a special education school for students with DHI in Turkey. Constraints in regards to the size of the sample were mitigated by employing mixed method approach via applying qualitative and quantitative measurements. This enabled the researcher to triangulate findings through multiple data sources and methods. In order to improve the credibility of the study, a careful effort was put in practice including research design and analysis and interpretation. The need for the protection and confidentiality of participants was taken into

consideration, so as to ensure the ethical treatment of the participants.

Students' social participation and motivation skills, as well as their academic skills development during the application of ICT materials were not assessed independently, but rather, by gathering perceptions from teachers and students. The findings are largely based on the perspectives of the interviewees, questionnaire and observation findings, which may not fully able to explain underpinnings of social participation and motivation skills of the students.

The strengths of research design included listening to the voice of children with DHI regarding their perceptions of ICT and Dikte. Language access for students to express their ideas was provided by interpreters for those who required sign language. Also, conducting this study in a naturalistic environment of the school enabled students and teachers to feel more 'at home' during the research. They did not move to different locations or spend any time to be prepared for research objectives such as reading some texts or bringing materials into classrooms.

This chapter concludes the research through a critical overview. Conclusions are drawn regarding the contributions of this study to the field and knowledge. It is hoped that this study will provide practical implications for policy makers, teachers and students in special education schools for students with DHI. This study has touched some topics, in that very limited research has been done. Therefore, it is hoped that this will pave the way for further studies that will ultimately benefit teachers, students with disabilities and DHI, special education teachers and policy makers.

6.2.1 Recommendation for Future Research

More research using randomised controlled trials is needed to examine the link between Dikte use and the development of academic skills of students with DHI. More specifically, further research should scrutinise the extent to which Dikte could meet the specific needs/requirements of students with DHI, such as accessing spoken lectures in text and audio formats and supporting learning with visuals (text transcriptions in this respect). This leads to the fact that further investigations should be undertaken to identify how conveying teaching in an audio-visual way simultaneously provides intermodal synchrony (referring more than one mode of information transferring) and how scientifically effective this way of information transferring is for developing comprehension in students with DHI. Also, further studies may be useful in assessing the actual effectiveness of Dikte with a larger population of people with disabilities in Turkish schools.

Further studies are needed to validate the kind of association which may exist between time spent on the preparation of ICT materials, the difficulties of managing computer programmes to prepare materials, and teacher retention and attrition. In relation to this, the effectiveness of creating a material pool through Dikte/SR in audio and text formats in terms of reducing the time spent on preparing materials could be further investigated.

Importantly, further investigations are required to analyse the educational advantages and disadvantages of top-down approach in Turkish context regarding providing ICT materials and pedagogy. As literature findings suggested that bottom-up model is more effective in enabling the teachers to have more voice and contribution on making education policy, it urges policy makers to revise Turkish regulations for top-down approach and its' possible outcomes in the education process of students with DHI.

More research on using whether a standard or differentiated curriculum in the education of students with DHI needs to be undertaken where scientific information could help to decide on how and to what extend each curriculum contribute to the academic developments of students with DHI by concerning their specific academic needs such as more visual based and sign language supported curriculum.

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APPENDIX A. ETHICAL APPROVAL FORM

THE UNIVERSITY OF WARWICK
Institute of
EDUCATION

Application for Ethical Approval for Research Degrees
(MA by research, MPHIL/PhD, EdD)

Name of student	MA By research	EdD	PhD
Eyup Bayram Guzel			✓

Project title: Teachers' and Students' Perspectives towards the Use of ICT in a Turkish school for pupils with hearing impairment.

Supervisor Professor. Dimitra Hartas

Funding Body:

Methodology

A questionnaire will be used to collect information from special education teachers on broad trends regarding the use of ICT and issues and challenges in using it with students with hearing impairment in particular. Similarly, the students' with hearing impairments demographic information will be gathered.
In depth individual interviews will explore the role of ICT materials in teaching and learning in general and for students with hearing impairments, at the same time investigating the possible advantages and disadvantages of a speech recognition program called "Dikte". Interviewees will be selected primarily on the basis of willingness.
Classroom observation will take place during the teachers' implementation of Dikte. The researcher, as a non-participant observer, aims to observe the behaviours and attitudes of the teachers' towards Dikte. It will enable the researcher to validate the teachers' words, obtained in the interviews, and be able to comment on what they do in practice.

Participants

The participants include special education teachers, students with hearing impairments, and school principals. The students' age range will be 11-15 years studying at secondary school with moderate hearing loss (between 40-70 dB). The students are not considered as vulnerable to the implementation of Dikte, and there is no indication that this research will cause any harm or discomfort. Because, Dikte is a speech recognition program which will be employed by their teachers in the classroom in order to improve the students' learning capabilities. The special education teachers are those teaching "Teaching Turkish Language", "Social Studies", "History", and "Science". The principals are those who are currently working at the school where this study will be conducted.

Respect for participants' rights and dignity

The participants will be required to formally indicate their consent to participate in the research. They will be given the opportunity to withdraw from the research at any time. Cultural and religious values will be carefully considered and respected by making sure the questions are not biased or harm any of the participants, and their records will not be available to anyone and they will be stored in a password protected folders.

Privacy and confidentiality

Firstly, the participants will be mailed the questionnaire after all the necessary consent has been collected. Then, interviews with students, teachers and principals will be held and they will have the right to withdraw any time during the study. All of the audio taped interviews, questionnaires and transcriptions will be stored with restricted access on an external hard drive in password protected folders. Personal or identifiable information will not be recorded or included in any printed documents in order to maintain confidentiality at all times. The participants will be informed that they are free to decide what information they are willing to share without any pressure or obligation to discuss issues that they do not feel comfortable with.

Consent

The participants will be informed about the research in advance of beginning the study. Consent form will be collected from the students, their teachers and families. The consent form will clarify the researcher's role, a brief overview of the project, and the time commitment required from them. In advance of interviews, the participants will be required to formally provide consent form, and then individual interviews will be set. The participants will be given enough time to consider whether to take part or not, or ask further questions about the research.

Competence

The data generated from in depth interviews, questionnaire and observation is going to be compared to each other in order to investigate possible correlations between the data sets. It will enable the researcher to validate the data obtained in the interviews and questionnaire from the teachers, the students and the principals and the researcher will be able to comment on what they do in practice.

Protection of participants

The researcher is going to make every effort to protect the safety, anonymity and well-being of the participants. He will try to anticipate circumstances where this might be threatened or will make arrangements to emphasize this accordingly. The participants will have right to withdraw whenever they want to during the research process. The participants' records will be safely stored in a restricted folder with password protection. They will also have right to require their own data and recordings and they will be informed that their recordings are going to be destroyed after a certain period of time. If any of the participants wish to invite a third person to support and feel more comfortable during the interviews, he or she will be given this right by the researcher. Also, there are no anticipated physical or emotional disadvantages of this research to the participants.

Child protection

Will a DBS (Disclosure and Barring Service formerly CRB) check be needed?

Signed

Research student [signature] Date 20/5/13

Supervisor [signature] Date 20/5/13

Action

Please submit to the Research Office (Louisa Hopkins, room WE132)

Action taken

☐ Approved

☐ Approved with modification or conditions – see below

☒ Action deferred. Please supply additional information or clarification – see below

Name G. Hinchliffe Date 25.11.13

Signature [signature]

THE UNIVERSITY OF WARWICK

CENTRE FOR EDUCATION STUDIES

Stamped

Notes of Action

There is much that is clear + well presented. However, there are issues to address still. ~~Please~~.

1. This does not address 'Competence' in terms of ethics.
2. Is this yes or no?
3. This should be addressed
4. This is a thoughtful Information Sheet but who is it for? Teachers? Students? Both? Given the age

APPENDIX B. INTERVIEW SCHEDULES

I. Information Sheet

THE UNIVERSITY OF WARWICK

Title: Teachers' and Students Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment.

Date: ___/___/20__

You are invited to take part in a research study which is being conducted as part of a

PhD degree at the Centre for Education Studies, the University of Warwick. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with the researcher if you wish. Please feel free to contact us if you would like more information or you have any concern regarding this research. Take time to decide whether or not you wish to take part.

What is the purpose of this study?

This study aims to explore how ICT support pedagogy and provide communication access for students with deafness and hearing impairment. Specifically, this study applies a speech recognition program to investigate how it could support teaching and learning processes of special education teachers and students with deafness and hearing impairment. Therefore, this study seeks to gather the perspectives of the teachers' and students'.

Why have you been invited to participate?

You have been invited to take part in this study because this study intends to collect your views as a special education teacher or student with hearing impairment.

Do I have to take part?

It is totally up to you to decide whether or not to take part. If you decide to take part, you have to sign a

consent form for this study. You will be free to withdraw at any time and without giving a reason. This decision will not affect you or your rights in any way.

What do I have to do?

You will be asked to sign a consent form and take part in an interview.

The questions are open-ended in nature and there will be no right or wrong answers. The interview session would take about 30 to 55 minutes for teachers, and 10 to 20 minutes for students.

Will my taking part in the study be kept confidential?

The use of any information that identifies you during the course of the research will be kept strictly confidential. This information will be kept in a secure place and only people involved in the study or authorised individuals will have access to it.

Contact details

If you would like any further information please contact:

Eyup Bayram Guzel

Institute of Education

University of Warwick

Coventry, CV4 7AL

Tel: +447961502211

Email: e.b.guzel@warwick.ac.uk

THE UNIVERSITY OF
WARWICK

II. Consent form

Project Title: Teachers' and Students Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment

Name of Researcher: Eyup Bayram Guzel

I confirm that I have read and understood the information sheet dated __/__/20__ for the above project which I may keep for my records and have had the opportunity to ask any questions I may have.

I agree to take part in the above study and am willing to have my involvement in the interview recorded.

I understand that my information will be held and processed for the following purposes:

- To be used anonymously for internal publication for a PhD project and submitted for assessment with a view to being published in academic journals / conferences.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason without being penalised or disadvantaged in any way.

Name of Participant	Date	Signature

Researcher	Date	Signature

III. Interviews: Covering letter

Title: Teachers' and Students Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment.

Dear Respondent,

I am writing to request your participation in my research project to interview special education teachers who have experience of using ICT materials in teaching. The purpose of this study is to find out how ICT provide communication access and pedagogical support in teaching and learning processes of students with deafness and hearing impairment. This is being conducted as a part of my PhD degree at the Institute of Education, University of Warwick. It should take you about thirty to fifty minutes to complete.

This interview is anonymous and your privacy will be respected. Your answers will not be linked to you personally in reporting or publishing the results in academic journals or conferences. There is no risk to your privacy if you choose to participate or not. You can request a copy of this study's results via emailing me at e.b.guzel@warwick.ac.uk.

Thank you in advance for your contribution in this study.

Sincerely,

Eyup Bayram Guzel

PhD Candidate

Institute of Education,

University of Warwick,

Coventry, CV4 7AL

IV. Interview Questions

Interview questions for teachers.

Title: Teachers' and Students' Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment.

This study investigates how ICT are used in special education schools to support pedagogy and communication access for students with hearing impairment. The aim of the study is to improve the quality of education that secondary schools provide in Turkey. Therefore, this study seeks to explore the perspectives of the teachers'. It will take between 30 to 60 minutes to complete.

Please put a tick in appropriate answers.

Questions related to the demographic profile of the teachers'.

Gender: ( )Female ( )Male

Age : ( )21–25 ( )26–30 ( )31–40 ( )41–50 ( )51–60 ( )61+

Teaching subject:( )Technology Design ( )Religion ( )Turkish Language ( )Science ( )Social Studies ( )Arts (Sport, Music, Hand Craft, Drawing)

( )Mathematic

Years of Teaching Experience in general: …… years

How many years of teaching experience do you have in special education schools for students with DHI? ..... years

Do you have a computer on your own at the school: ( )Yes ( )No

Did you have any training course before beginning to work in this school?( )Yes( )No

Did you have any training course after beginning to work in this school?( )Yes ( )No

Which is your main language preference at the school? ( ) TSL ( )Oral

Do you know Turkish Sign Language? ( ) No ( ) Beginner ( ) Intermediate ( ) Advanced

How did you learn TSL? ( )By yourself ( )In TSL course ( )From Students

Did you have any in-service teacher-training course about ICT use before beginning to work in this school? ( )Yes ( )No

Interview Questions for special education teachers:

1. What are the current available ICT that you use in the school for students with hearing impairment? (hardware, software, online resources)
2. Can you describe the value or role of these ICT devices for your teaching? (ex; FM systems, computers, online resources)
3. To what extent do you perceive these ICT as effective for your teaching?
4. To what extent does the use of ICT result in changes in the way that you teach?
5. What are the challenges you face during ICT implementation in the classroom and at the school?
6. Do you have sufficient opportunities to use these ICT for teaching purposes at the school?
7. What are the perceived advantages and disadvantages of the use of Dikte in teaching for you?
8. How do you regard Dikte as the potential of ICT based learning?
9. Can you discuss other things that you observe during Dikte implementation?
10. What are the barriers you face during technology usage in the teaching process?
11. What advice would you give to the school administration to improve the use of ICT in teaching and learning?

V. Interview Questions

THE UNIVERSITY OF WARWICK
Institute of EDUCATION

THE UNIVERSITY OF WARWICK

Interview Schedule and Questions for students with DHI

Title: Teachers' and Students' Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment.

This study investigates how ICT are used in special education schools to support pedagogy and communication access for students with hearing impairment. The aim of the study is to improve the quality of education that secondary schools provide in Turkey. Therefore, this study seeks to explore the perspectives of the interviewers. It will take between 10 to 20 minutes to complete.

Demographic Questionnaire for the Students with Hearing Impairment

1. Gender: ( )Female ( )Male
2. What is your age?

3. Which grade are you in?

4. What is the degree of your hearing loss? ( )Mild (26-40 dB) ( ) Moderate (40-70 dB)

5. Do you use cochlear implant? ( ) Yes ( )No

If yes, how long have you been using cochlear implant? ……..

6. Do you know your age at diagnosis of hearing loss?

If yes, at what age? …….

7. Do (or did) your mother or father have hearing loss? ( )Yes ( )No

If yes, who are they? ( )Mother ( )Father

8. Do any of your siblings in your family have hearing loss? ( )Yes ( )No

If yes, who are they? ( )Brother ( )Sister

9. Which communication mode (sign or oral language) used in your home? ( )Sign Language ( )Oral Language

Interview questions for students with hearing impairment

1. Which ICT materials do you think useful for you?
2. Do you think that the use of technology in your courses helped you in your learning?
3. What do you think about the teachers make good use of technology in the classroom?
4. How do you think Dikte may help you in your learning?
5. What are the advantages or disadvantages of Dikte for your learning?

VI. Interview Questions

Interview Questions for Administrators.

Title: Teachers' and Students' Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment.

This study investigates how ICT are used in special education schools to support pedagogy and communication access for students with hearing impairment. The aim of the study is to improve the quality of education that secondary schools provide in Turkey. Therefore, this study seeks to explore the perspectives of the interviewers. It will take between 20 to 30 minutes to complete.

Questions for Administrators

1. Is the ICT development plan part of the school improvement plan, and does it reflect the school's ICT policy and the school's aims?
2. To what extent did the institutional discussions on and experiences with the use of ICT have contributed to whole school development?
3. What implications do you think will Dikte have on budget, use of rooms, infrastructure, timetable, technical support, staff training, etc?
4. How well are teachers in your school supported in their use of ICT through continuing professional development, ready access to ICT resources and technical support?
5. How do you think ICT can help the school to improve pedagogical and curricular activities?

APPENDIX C. QUESTIONNAIRE

Title: Teachers' and Students Perspectives towards the Use of ICT in a Turkish School for Pupils with Hearing Impairment

Dear Respondent,

I am writing to request your participation in my research project to survey special education teachers who have experience of using ICT materials in teaching. The purpose of this study is to find out how ICT provide communication access and pedagogical support in teaching and learning processes of students with deafness and hearing impairment. This is being conducted as a part of my PhD degree at the Institute of Education, University of Warwick. It should take you about fifteen to twenty minutes to complete.

This questionnaire is anonymous and your privacy will be respected. Your answers will not be linked to you personally in reporting or publishing the results in academic journals or conferences. There is no risk to your privacy if you choose to participate or not. You can request a copy of this study's results via emailing me at e.b.guzel@warwick.ac.uk.

Thank you in advance for your contribution in this study.

Sincerely,

Eyup Bayram Guzel

PhD Candidate

Institute of Education,

University of Warwick,

Coventry, CV4 7AL

IX. Information and Communication Technology Usage Survey

This survey is presented here without directions and "other please specify" items appearing under each heading as the last item. Please tick the boxes as appropriate.

Do you have your own computer? Yes ( ) No ( )

Do you have computer at school? Yes ( ) No ( )

Do you have Internet connection at home? Yes ( ) No ( )

Do you have Internet connection at school? Yes ( ) No ( )

Daily Computer Usage: Less than an hour ( ), 1-3 hours ( ), 3-5 hours ( ), More than 5 hours ( ).

Software Usage Very Good	Good	Average	Bad	Very Bad
Word Processors (Word etc.)				
Spread Sheets (Excel etc.)				
Presentation Software (PowerPoint etc.)				
Databases (Access etc.)				
Computer Aided instruction software				
Web page development tools				
Web browsers				

Search engines					
Electronic mail					
Discussion List and newsgroups					
Chat and/or forum					
Electronic Encyclopaedia					
Instructional films (video, CD)					

Usage of Instructional Materials	Very Frequently	Frequently	Sometimes	Rarely	Never
Board					
Overhead Projector					
Projector /camera					
Multimedia Computer					
Computer-Projector system					
Internet/Web environment					
Television/Video					
Radio Cassette Recorder					
Video Camera					
Slide Projector					
Printed Materials (journals, books)					

Professional Development About ICT	I strongly prefer	I prefer	Neutral	I don't prefer	I never prefer

Internet					
Printed Materials					
Self experiment					
Participating seminars/taking courses					
In-service education					
Experienced teachers on ICT					
Colleagues					
Other colleagues in different schools					
Technical support units in the school					

Factors encourage technology usage	Very important	Important	Neutral	Not important	Not applicable
Rewarding the technology usage efforts of teachers in instructional activities					
Investments of the institutions on infrastructure of instructional strategies					
Investments of the institutions on in service education programmes of instructional strategies					
Investments of the institutions on the support services of instructional strategies					
Developing the policies and plans for diffusion of the instructional technologies					
Providing support for the					

projects towards the expansion of instructional materials					
Carrying out the studies for integration of technology into curriculum					

Perceptions about use of ICT	I strongly agree	I agree	Neutral	I don't agree	I strongly don't agree
I don't use computers as much as other resources (books, overhead projectors etc.) for instructional purposes					
I know what to do for using computers in instructional environments					
I am aware of the opportunities that computers offer					
I can answer any questions my students as about computers					
I am not sure that I am computer literate for use computes in classes					
I don't want to use computers					
I think that I can use instructional technologies in class activities more effectively day by day					
I believe that tools like email, forum and chat will make communication with my colleagues and students					

easier					
I believe that technology supported teaching makes learning easier					
I think the use of instructional technologies increases the interests of students towards courses					
I think the use of instructional technologies increases the quality of courses					
I think the use of instructional technologies makes it easier to prepare course materials					
It is hard for me to explain the use of computer applications to my students					
I think technology makes effective use of class time					
I think using instructional technologies makes me more productive					

Barriers to Technology Usage	I strongly agree	I agree	Neutral	I don't agree	I strongly don't agree
Inefficient time to prepare materials based on technology					
Inefficiency of teachers' technical knowledge to prepare materials based on technology					
Inefficiency of institutions computer laboratory					

Inefficiency of institutions technical infrastructure about instructional technologies					
Inefficient number of media (printer scanner) for effective use of computers					
Shortage of computers used by teachers					
Absence of reward systems for encouraging technology usage					
Poor technical and physical infrastructure of earning environments					
Inadequacy of computers used by learners					
Inadequacy of guidance and support by administration					
Insufficiency of financial resources for technology integration					
Deficiency in professional development opportunities for gaining knowledge and skills					
Deficiency in support services in material development					
Lack of interest of teachers in technology usage					
Inadequacy of the courses of technology offered to students					

X. Information and Communication Technology Usage Survey (Turkish Version)

Bilgi ve Iletisim Teknolojileri Kullanim Anketi

Bu anket sizlere lutfen diger secenek varsa belirtin seklinde bir secenek sunmamaktadir.

Kendi bilgisayariniz varmi Evet( ) Hayir ( )

Okulunuzda kendinize ait bir bilgisayar varmi Evet( ) Hayir ( )

Evinizde internet baglantiniz varmi ? Evet( ) Hayir ( )

Okulda internet baglantiniz varmi? Evet( ) Hayir ( )

Günlük Bilgisayar Kullanimi: 1 saatten az ( ), 1-3 saat arasi( ), 3-5 saat arasi ( ), 5 saatten fazla ( ).

Software Kullanimi	**Cok iyi**	**Iyi**	**Normal**	**Kotu**	**Cok Kotu**
Yazi Islem (Office Word vb)					
Tablo Cizelge (Excel vb)					
Sunum (powerpoint vb)					
Veritabani					
Bilgisayar Destekli Egitim Programlari					
Internet sayfasi gelistirme araclari					
Sayfa tarayicilari(explorer,chrome)					

E mail kullanimi					
Haber ve tartisma bloglari					
Chat ve/veya forum					
Elektronik ansiklopedi ve atlas					
Instructional films (video,CD)					

Egitsel Arac ve Gerec Materyal Kullanimi	Cok Sik	Siklikla	Bazen	Nadiren	Hic

Akilli tahta					
Tepegöz					
Projector /kamera					
Yazili Materyaller					
Bilgisayar-Projector sistemi					
Internet/Sanal ortam					
Televisyon/Video					
Kamera ve Ses kayit					

BIT ler Adina Profesyonel Gelisim	Kesinlikle tercih ederim	Tercih ederim	Kararsizim	Tercih etmem	Kesinlikle tercih etmem
Internet Kullanimi					
Seminerlere Katilim					
Extra destek alimi					
Hizmet ici egitimlere katilma					

Deneyimli ogretmenlerden destek alma					
Diger okullardaki deneyimli ogretmenlerden destek alma					
Okul bilgisayar ogretmeninden destek alma					

BIT Kullanimina Etki Eden Faktörler	Cok önemli	Önemli	Kararsizim	Önemsiz	Alakasiz
Ogretmenlerin Teknoloji kullanim becerilerini odullendirme					
Okullarin teknolojik altyapilarini destekleme					
Hizmetici teknoloji kullanim egitimlerini gelistirme					
Okullarin disardan teknoloji destegi almalari					
Teknolojik uygulamalar adina plan ve program gelistirme					
Okullardaki teknolojik projelerin desteklenmesi					
Teknolojinin mufredata uyumu icin akademik calismalarin yapilmasi					
Ogretmenlerin is yukunu azaltici egitsel programlarin uygulanmasi					

BIT lerin Kullanimi Adina Ögretmen Görüsleri	Kesinlikle Katili yorum	Katili yorum	Kararsizim	Katilmi yorum	Kesinlikle katilmi yorum
Bilgisayari, kitap ve tepegoz gibi materyallerden daha fazla kullanmak benim icin onemlidir					
Egitsel etkinliklerde bilgisayari nasil kullanacagimi biliyorum					
Bilgisayarin sundugu egitsel faydalarin farkindayim					
Ogrencilerimin bilgisayar hakkinda soracagi bircok soruya cevap verebilirim					
Egitsel bilgisayar tabanli etkinlikleri hergun daha iyi sinifimda kullanabiliyorum					
Email ve bilgi paylasma platformlarinin ogretmen ogrenci iliskilerini artirdigini dusunuyorum					
Teknoloji destekli egitimlerin cok faydali olacagini dusunuyorum					

Teknoloji destekli egitimlerin ogrencilerin Ilgilerini cekecegini dusunuyorum					
Teknoloji kullaniminin verilen kurslarin etkisini artirabilecegini dusunuyorum.					
Teknolojinin yazili materyallerin hazirlanmasini kolaylastirdigini dusunuyorum					
Egitsel teknolojik materyallerin kullanimi daha etkili egitim vermemi sagliyor					
Sinifta kullandigim egitsel teknolojilerin sinif disi kisiler tarafindan degerlendirilmesini hos bulmuyorum.					

Demographic Questionnaire for the Students with Hearing Impairment (Turkish Version)

Demografik Anket İşitme Engelli Öğrenciler İçin

1. Cinsiyet, ( )Bayan ( )Bay

2. Kac yaşındasınız? ……

3. Hangi sınıf seviyesinde okumaktasınız? …….

4. İşitme kaybınız nedir?( )Hafif (26-40 dB) ( )Orta (40-70 dB)

5. Koklear İmplant kullanıyormusunuz? ( ) Evet ( ) Hayir

Eger evet ise, ne kadar süredir kullanmaktasınız? ……

6. Kaç yaşında işitme engelli teşhisinin sizin adınıza konulduğunu biliyormusun? ……

7. Anneniz veya babanızda işitme kaybı veya sagırlık varmı/varmıydı? ( )Evet ( )Hayir

Eğer evetse, kim bunlar? ( )Anne ( )Baba

8. Kardeşlerinden işitme engelli veya sağır olan birileri varmı?

Eğer evetse, kim bunlar? ( )Erkek kardeş ( )Kız kardeş

9. Evde hangi yolla işaret dili veya oral iletişim kuruyorsun? ( )Isaret Dili ( )Oral Dil

Information and Communication Technology Teacher Questionnaire (Turkish Version)

Bilgi ve Iletisim teknolojileri Ogretmen Anketi

1. Cinsiyet ( )Bayan ( )Bay

2. Kac Yasindasiniz? …….

3. Kacinci sinifi okutmaktasiniz? …..

4. Hangi brans? ( ) Technology tasarim ( ) Din kulturu ( ) Turkce ( )Fen bilgisi ( )Sosyal bilgiler ( )Sanat (beden,resim,muzik) ( ) Matematik

5. Kac yillik ogretmensiniz?

6. Okulda kendinize ait bir bilgisayariniz varmi? ( )Var ( )Yok

7. Isitme engelliler okulunda kac yillik tecrubeniz var? ……..

8. Bu okula gelmeden once isitme engelliler ogretmeni olabilmek icin bir egitim (hizmet ici veya kurs) aldinizmi? ( ) Evet ( )Hayir

9. Isaret dili biliyormusunuz? ( ) Hic bilmiyor ( ) Baslangic duzeyi ( ) Orta duzey ( ) Iyi derecede

10. Bu okula gelmeden isaret dili egitimi aldinizmi? ( )Evet ( )Hayir

11. Bu okula geldikten sonra isaret dili egitimi aldinizmi? ( )Evet ( )Hayir

12. Bilgi ve iletisim teknolojileri konusunda bu okula gelmeden hizmet ici egitim veya kurs aldinizmi? ( )Evet ( )Hayir

APPENDIX D. An Except from an Interview with a Student and Teacher.

An Except From Interview with Teacher 14
1.What are the ICT materials that you use in your classroom?
Currently I am using FM system to transfer sound in better quality format to the students hearing devices, then hearing devices which are very crucial to transfer sounds into ear, also I use computer and computer based programs effectively in my classrooms, since my background is also computer technician, I can say that I am the most knowledgeable person in this school in terms of computer usage. Our students need to receive each information visually, this is something that we have to bring into classroom, we teach them how to write but most of the writings become meaningless for them unless they see the visual corresponding of the written texts or vocabularies etc, I try to give vocabularies with their visual components as much as I can, I teach how to use new vocabularies in sentence with visual supports, I also use social media tools like face book to communicate with the students, because trying to communicate with them by writing is important for them to improve their writing skills, I have used Dikte with you in your study, transferring teachings by a machine not by directly teacher has made these students excited.
2.How about the educational benefits of these materials that you use?
The first benefit is I think prepare teachers to come to the class ready, we will have prepared materials to use, will have material pool, we can categorise prepared materials regarding to the students' academic levels and each teacher will take advantage from this material pool. In normal schools, when a teacher enters a classroom, by studying 3-5 minutes, he or she will be ready and know how to convey the teaching subjects, however, we as special education teachers are different, we have to assess or evaluate if the subject can be acquired by these students with DHI, or we should consider their academic levels, we have to think 4-5 different approaches or strategies at least, so we have to be prepared before the class, so the more we use ICT materials, the better we become in the classroom to teach.
3.How about educational computer software in terms of their role in education?

This is my 15th year as a teacher, when I first came to this school, I realised that some of the teachers who came from general education schools were basically writing the vocabularies on the board and the students were just copying them into their notebooks, so when I conducted a study about how many words that secondary levels students were using, the result was between 250-300 words, they were only able to use these vocabularies in their lives, today they know around 2000 words, how it happened is that I and some of other teachers have been using computers, applications, visual graphs, vocabulary charts, paintings, pictures, colourful visuals demonstrating vocabularies etc. So, when the students began seeing and playing with these materials, learning happened automatically. This is how ICT has affected our students' learning and the way that we transfer teachings or knowledge to them.

4.How about positive and negative sides of ICT?

I have to say that in our school, there is no specific course or training about material preparation, so it depends on the teacher's decision whether to prepare ICT or other means of teaching materials, if the teachers want to distribute study books to the students they do, they sometimes may not, they may say, open the page A, and read the texts until page B. I mean, there is no obligation to prepare something. We were not asked if we need different kinds of materials or not. Not our entire teachers use computer effectively, some of them even do not use or some of us may not draw pictures, so we have to be provided teaching materials or be trained in this respect. For example, I can use computer very well but I cannot draw charts or pictures on the board, one of our teachers are very good at drawing cartoons to convey teaching subjects, he was very effective in the class. So, there is negative side of computer if the teachers are not good at using it.

5.What is your perception about Dikte?

I know that almost %80 of our students have severe to total hearing loss, so do this kids hear? But, it was great for them to be able to see what was spoken in the classroom as in text format on the board, they got very excited. I think the important thing is to make every teaching visual. We should develop our technology usage and teaching materials. In the past, I was using computer to teach, but not computer software or game based learning activities. So, I have started to use them in recent past. I am trying to provide as many computer programs as possible and they are effective. Dikte is a very new and unique program; I was surprised when I experienced its features and your idea to use it in our school for these students with DHI. My students were very excited and happy as

well, when they were seeing my speeches on the board as in text.

6.How about the students' academic achievements or comprehension abilities?

First of all, it is a very significant issue to convey teachings in visual and audio format together, I think this is what our students need, thanks for bringing this idea to us. Now for Dikte, I have implemented it around 10 weeks with your assistance, and distributed texts of Dikte after the classes were done. Also, I uploaded Dikte sound files into classroom computer. So, now with Dikte, I think it was more effective for students with cochlear implants, because what I was seeing is that, these students were receiving the sound signals better than the other students, so they were more aware of my speech, my words and Dikte transcriptions, it was unique to assess or test whether what they were hearing was correct or not. I mean, Dikte has provided great feedback as in written format simultaneously while I was talking.

I did not allow students to use Dikte but I want to, I think if we use it for students with good speaking skills, it would be great to improve their pronunciation skills. Dikte was not recognizing single letters when it was said alone, for example like s, t, r etc, Dikte was guessing what I was going to say and write a whole word, so it was sometimes causing difficulties for me, but I got used to it.

7.How about its effectiveness on material preparation?

I was very pleased and glad to experience such a technology and I was very hopeful at the beginning, ones I began implementing Dikte, I understood its importance on my students. I mostly used Dikte for important parts of my speech, I mean when my students needed to take notes, so they did not. I used to give writing tasks a lot, but I thing it was not very helpful. Now these students can study from Dikte notes, they can do writing if they want as well on Dikte notes. Another point is that we can use Dikte to collect classroom data, I mean we can use Dikte notes to create teaching materials pool and it will be great to see how other teachers convey the same subjects or see what kind of teaching strategies they have. Also, for Dikte sound files; these students need to listen to natural speeches regularly, because this is what they need. Recording my sound and uploading them in their computers or in school computers can be very effective way of educating them. Because, these students need to learn basic communication, basic sentences and learning subjects. The more they listen to my teachings, the better I guess they become at comprehending. Also, their families will be informed about their kids

learning activities, classroom teachings, different subjects, and be able to track their kids' educational progress.

8. Do you want to use Dikte further in your classes?

Absolutely, I personally want to use it from beginning of the next year.

9. How about the contribution of Dikte for your school's general missions and yours?

Our schools for hearing impaired have similar missions as ministry of education controls all of them. The main mission is to provide oral education, I mean using oral approach, speaking. This approach has been receiving more attention each year. For example, normal schools having hearing impaired students use oral language and approach. When it comes to our schools, we largely use and have to use sign language; we need something that encourage students and teachers to use oral approach. Our job, using oral language becomes more difficult since many of our students families and friends are hearing impaired, they use sign language among each other. Our biggest barrier I guess teaching audily, I mean educating students audily, developing their listening and speaking skills. We have to make sure and encourage these students with programs like Dikte that they can speak or understand sounds upto some levels, even if they do not speak, they may understand what they hear. Dikte in this respect has a very promising feature. We have to see its effectiveness in long term.

Also, if we can use Dikte in a way that students can speak in it and try to train their speaking skills, it would be great. If Dikte can do it, I think it can be much more effective and helpful.

The researcher: Thanks a lot,

You are welcome.

An Except From an Interview with Student 10

1.Which technological tools you have in the class?

We have FM system, projector, computer, computer games and activities.

Visuals?

Yes, we have pictures everywhere in the class and my teachers always show pictures via computer.

2.How about their advantages for you?

I like the most painting and playing games on computer, we sometimes do quizzes on computer.

3.How about FM system's impact?

It has been 1.5 years since beginning to use FM system in my classroom, it is very effective, I can hear clearly, because my hearing loss is 70%, so I can hear better than most of my friends, I got used to it.

4.What else like computers, visuals, games?

We watch videos, our teachers try to explain teachings with pictures, it is fun, pictures are better than our books, they are boring, also most of my friends do not understand the texts in our books, but when teachers use pictures, it is easier to understand.

5.What is your overal perception about Dikte?

It is like video subtitle but live. I was sometimes having difficulty of following the texts and reading them, but my teachers were speaking slowly. I could understand the teachings better but I think it was a little bit tiresome.

6.What else did you like about Dikte?

Some of my teachers were using Dikte to create stories with pictures like stories were being written next to the pictures, then they were giving print outs to us. I really liked it especially we got print outs in Turkish Language and Social studies lessons. Then, in social studies lesson, our teacher were spoken into Dikte and it was writing the city names on Turkish map on the screen. Also, Ali ogretmen showed us pictures of vegetables on the screen, then he told the names of the vegetables and Dikte wrote them under the each picture. It was very fun because he was standing in his table and just speaking. Sometimes, he was deleting texts on the screen and correcting them.

7.How about Dikte print outs for your academic development?

My teachers have given many print outs, some of them were very colourful and with different characters. They have also put some sound files into the classroom's computer, I have listened 3 of them, they were teachers' voices and their teachings. I think it was very good and interesting because

I became like living the same day in the classroom again.

8.How about the language of the print outs in terms of understanding?

It was easy to read from print outs because sentences were short and clear, not like our books, they are very difficult, almost none of my friends completely understand our books. There were some print outs with pictures, they were better and nice, I was able to understand the covered topics better. For example, in science class, teacher gave us print out about human body parts, it was easier to understand then our book.

The Researcher: Thanks a lot for your time.